



Hardy Fern Foundation Quarterly



Spring 2009

THE HARDY FERN FOUNDATION

P.O. Box 3797

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Web site: www.hardyferns.org

The Hardy Fern Foundation was founded in 1989 to establish a comprehensive collection of the world's hardy ferns for display, testing, evaluation, public education and introduction to the gardening and horticultural community. Many rare and unusual species, hybrids and varieties are being propagated from spores and tested in selected environments for their different degrees of hardiness and ornamental garden value.

The primary fern display and test garden is located at, and in conjunction with, The Rhododendron Species Botanical Garden at the Weyerhaeuser Corporate Headquarters, in Federal Way, Washington.

Satellite fern gardens are at the Birmingham Botanical Gardens, Birmingham, Alabama, California State University at Sacramento, Sacramento, California, Coastal Maine Botanical Garden, Boothbay, Maine, Dallas Arboretum, Dallas, Texas, Denver Botanic Gardens, Denver, Colorado, Georgeson Botanical Garden, University of Alaska, Fairbanks, Alaska, Harry P. Leu Garden, Orlando, Florida, Inniswood Metro Gardens, Columbus, Ohio, New York Botanical Garden, Bronx, New York, and Strybing Arboretum, San Francisco, California.

The fern display gardens are at Bainbridge Island Library, Bainbridge Island, WA, Bellevue Botanical Garden, Bellevue, WA, Lakewold, Tacoma, Washington, Les Jardins de Metis, Quebec, Canada, Rotary Gardens, Janesville, WI, University of Northern Colorado, Greeley, Colorado, and Whitehall Historic Home and Garden, Louisville, KY.

Hardy Fern Foundation members participate in a spore exchange, receive a quarterly newsletter and have first access to ferns as they are ready for distribution.

Cover Design by Willanna Bradner

HARDY FERN FOUNDATION QUARTERLY

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Volume 19

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Editor- Sue Olsen



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President's Message Spring 2009

The fresh new crociers are just swelling up and will be unfurling soon to replace the old weathered fronds that have been clipped off of almost all of my ferns. The same is true of our main display garden at the Rhododendron Species Botanical Garden. I have been there quite a lot lately working on a few projects that have been in the works for some time. One of the most exciting is the HFF's new stumpery. Over 130 gnarled and shapely trunks have been placed over a generous half-acre on a gentle slope under mature Douglas firs. This spectacular new garden was just installed in January and we are now busy planting hundreds of ferns throughout this Victorian revival garden.

Along with the stumpery, a new nursery hoop house is being built to replace the old structure that collapsed in the snow this winter. The new hoop provides over twice the space (approximately 30 feet by 90 feet) and will allow for an increase in our production of rare and unusual ferns. I look forward to seeing the results of this expansion in future plant distributions. Thank you to Paul Thompson and his "Thursday Volunteer Crew" and to John van den Meerendonk and his landscape crew for making this project possible and for making it happen on such short notice! John and his crew also deserve a very special thank you for all of the time spent putting the stumpery in place and following up by spreading endless yards of compost and wood chips. Watch the progress of both of these projects on our new and developing website www.hardyferns.org.

At the end of March, Michelle Bundy, curator of the HFF fern collection at RSBG, and I had the opportunity to visit one of our at large board members, Naud Burnett in Dallas, Texas. Naud is the owner of the huge wholesale fern nursery, Casa Flora and the designer of the Fern Dell at the Dallas Arboretum, one of the HFF satellite gardens. Both Michelle and I had a wonderful time enjoying the full glory of a Texas spring. One of the highlights was touring Naud's private collection at the nursery. The greenhouse was loaded with choice and exceptional specimens and beautiful stock plants. The Fern Dell at the arboretum is in a lovely wooded setting complete with a stream running through the center. The trip ended with a lecture for the Southwest Fern Society. This group of dedicated individuals has an active schedule of trips and gatherings planned for the near future. I wish them happy ferning in their travels.

This second commemorative issue celebrating our 20th anniversary is focused on fern "how to's", from starting a fern garden to growing in assorted special situations. I hope you will enjoy the wit and wisdom of our contributors.

If you are in the Seattle area on June 5th or 6th stop by our annual Fern Fest lecture and plant sale. On Friday night we will have our annual members' meeting and elect new officers (I will turn over the presidency and rejoin the ranks of the regular board members.) That will be followed by our founder Sue Olsen's lecture on "Ferns of the World". And as always the sale will offer a tremendous selection of treasures as well as good advice and plenty of good company. Check out the website for the details.

All the best,
Richie Steffen

From the editor,

We hope you, the readers, enjoy this special issue and are inspired to expand your fern collections or try growing them in new and different ways. And to the contributors, many, many thanks for sharing your expertise and taking the time to challenge our imaginations with articles that are interesting and informative as well as fun to read. You've made this special issue very special indeed. Finally, my enthusiastic thanks to Michelle Bundy for her competence and good cheer in putting this all together so well.

*Sincerely,
Sue Olsen*

How you might get started with ferns

Lyman Black
Seattle, WA

So you think you might try out some ferns? Good idea. Let me encourage you. They can be very rewarding. Perhaps you've heard they're about the oldest growing things on the planet. Little has changed for over 350 million years! Ferns will add a real feeling of maturity to your garden, a change of pace and diversity of texture. And most are not difficult to grow if you provide the basics: soil, shade, and water.

You're fortunate if some friend took you to our Hardy Fern Foundation Festival in June. There you get a good idea of the many types of ferns available in temperate climates. You see that ferns are evergreen and deciduous, are of all sizes and textures and adapt quite readily to the conditions you provide.

You may be thinking about which ferns and where in your garden they might be happy. Happiness helps ferns too. Happiness is good water, and shade for ferns. And which one of us doesn't have a shady north side of our house or some trees that will filter out hot sun

One persistent fern lover told me at the Flower and Garden Show that she used to hate going to the back (north) side of her house. It was dark and ugly until she found ferns. Today it's her favorite part of her garden!

I was lucky to find I had an ugly, untended, soggy and shade-covered side of the home I moved into. Who would think that a joy? But ferns had just been introduced into my garden life, so this discovery provided the motivation to move me off dead center. But how do you start? The following thoughts include some from my introduction to fern growing. I hope they give you the encouragement you need to start yours.

At one of the Flower Shows I was given some lists. One was from "Great Plant Picks" and from another I found lists of ferns adaptable under different growing conditions such as: soggy, drought tolerant, deep shade or rockery. The fern names, of course, were impossible to pronounce, but often I found common names like sword fern or maidenhair or tassel fern which I thought might be useful.

Being successful with my first attempt seemed an important objective. I decided a shady area under some fairly large trees might do for a start. Nothing but morning sun filtered into most of the area, but the light in the sky was good most of the day, particularly when the deciduous leaves were down.

Checking the soil, I found it was kind of compacted, so I poured a watering can of water rapidly on it, only to see the water run off and not sink in. It appeared some help was desirable. Likely a bag of compost mulch or planting soil worked in about 8 inches to a foot would loosen and lighten my bed area of about 20 square feet and it did.

My water source was another challenge. You might have it easy finding a hose bib on the side of the house or around the corner. Hose bibs, of course, mean someone has to be out with a hose every 2 or 3 days, maybe not in the rain, but more on very hot days. But then if you have to fill a watering can in the sink, perhaps you would be better to pick a smaller area for the ferns until they are established. I had to remember, though, that water, constant water, at least regular water is one of the three legs of this stool: soil, shade, and water!

In my case, I figured 5 to 7 types of ferns would be plenty to give me a toe in the water. Thus I could learn before I added variety. The list of ferns liking different conditions was a good source. (I've attached the short list below and also suggested reference books for your study). I picked out 3 of the names from that list to fit my locations. Here I would place 3 in a cluster about 1 1/2 feet apart. Over there, between the rhododendrons I broke up the monotony of broad leaves with a different texture. I also liked the idea of using ferns around the base of my trees.

Finally came the need for a decision about which ferns to plant in my garden. This was an early effort at landscape design, I felt, so I pulled out my lists and went to work. I wanted first to make enough of a showing so the ferns would not be overlooked by someone familiar with my garden. I picked 3 substantial names, tassel fern (*Polystichum. polyblepharum*) autumn fern (*Dryopteris erythrosora*), and sunset fern (*Dryopteris lepidopoda*). Hearing new shoots (crosiers) came up with color that might be interesting with my green leaves, I planted the 3 sunset ferns in a 2' x 5' open bed area about 14 inches apart. In front of the sunset, I liked the idea of the little evergreen maidenhair (*Adiantum venustum*) that would spread and fill up the ground and reduce weeds.

Next I looked at my bed of azaleas that give me lovely color in spring bloom, but fade to small leaved monotony for most of the rest of the year. Here I picked the autumn fern (*D. erythrosora*) to break up the sameness with colorful and wavy texture. Just one plant was slipped in between two azalea plants that were a foot apart. I could have gone smaller but this area seemed the right size for my plan

Finally, I wished to identify the corner of the property where two fir trees provided a high canopy. Under these trees I selected two tassel ferns (*P. polyblepharum*) with broad and glossy fronds to stand in front of an older sword fern (*P. munitum*) for contrast. Adjacent to these I also placed another native, deer fern, (*Blechnum spicant*) to contrast with the tassel fern.

Fortunately, these selections only required water in 3 locations, unless, of course, I decided to add a small computer on my hose bib to provide regular water. I didn't go that route right away, but I confess it called me sooner or later.

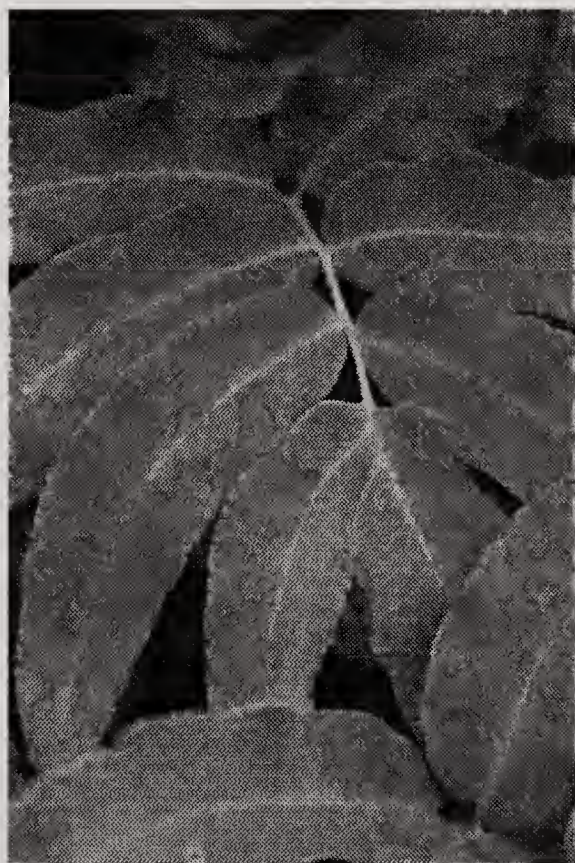
So here I had five different species and looks to go with my proven sword fern. They are mostly evergreen, and likely they will need some care next March to cut out the oldest fronds, which are curling. March should catch this trimming before growth of the new shoots (crosiers) makes it difficult. Actually you can remove any tired or broken fronds any time you wish to keep the ferns neat, but I prefer to give the attention at one time in early spring.

You've been most patient to stay with this story of my developing interest, and I do hope your experience, should you undertake this challenge, will reward you as it has me.

There are some wonderful books I've found since being infected with ferns. When you feel the need for more information, you might look up 'Ferns For American Gardens' by John Mickel, former Curator for Ferns at the NY Botanical Garden. This and several others will give you the descriptions and pictures you need. Of course, when you are really committed, you must investigate the Mercedes of fern books from the Editor of this quarterly publication, Sue Olsen, with her new 'Encyclopedia of Garden Ferns', published by Timber Press in 2007. Save your money and get invested.

EVERGREEN FERNS

Adiantum venustum - himalayan maidenhair
Arachniodes simplicior - east indian holly fern
Asplenium scolopendrium - hart's tongue fern
Asplenium trichomanes - maidenhair spleenwort
Blechnum chilense
Blechnum penna-marina - alpine water fern
Blechnum spicant - deer fern
Cyrtomium spp. - holly fern
Dryopteris championii - champion's wood fern
Dryopteris erythrosora - autumn fern
Dryopteris formosana - formosan wood fern
Dryopteris lepidopoda - sunset fern
Dryopteris wallichiana - wallich's wood fern
Polystichum braunii - braun's holly fern
Polystichum neolobatum - long-eared holly fern
Polystichum polyblepharum - tassel fern
Polystichum setiferum - soft shield fern



Dryopteris sieboldii
Photo courtesy of Arlen Hill

SUN TOLERANT FERNS

Asplenium trichomanes - maidenhair spleenwort

Athyrium filix-femina - lady fern

Blechnum chilense

Blechnum penna-marina -alpine water fern

Ceterach officinarum - rusty-back fern

Dryopteris affinis -scaly male fern

Dryopteris x complexa

Dryopteris erythrosora - autumn Fern

Dryopteris filix-mas - male fern

Osmunda regalis - royal fern

Polypodium glycyrrhiza - licorice fern

Polystichum munitum - sword fern

Woodsia polystichoides



Blechnum chilense

Photo courtesy of Richie Steffen

FERNS FOR WET SOILS

Dryopteris celsa -log fern

Dryopteris carthusiana - toothed wood fern

Dryopteris goldiana - goldie's wood fern

Matteuccia struthiopteris – ostrich fern

Onoclea sensibilis - sensitive fern

Osmundastrum (aka *Osmunda*) *cinnamomea* - cinnamon fern

Osmunda regalis - royal fern

FERN FOR DEEP SHADE

Adiantum aleuticum - western maidenhair fern

Asplenium scolopendrium - hart's tongue fern

Athyrium filix-femina - lady fern

Blechnum spicant - deer fern

Cyrtomium (all species) - holly ferns

Dryopteris dilatata - broad wood fern

Dryopteris filix-mas - male fern

Gymnocarpium - oak fern

Polypodium glycyrrhiza - licorice fern

Polystichum acrostichoides - christmas fern

Polystichum braunii - braun's holly fern

Polystichum munitum - sword fern

Polystichum setiferum - soft shield fern

DROUGHT TOLERANT FERNS

Athyrium filix-femina - lady fern

Blechnum penna-marina - alpine water fern

Dryopteris filix-mas - male fern

Polypodium glycyrrhiza - licorice fern

Polystichum braunii - braun's holly fern

Polystichum munitum - sword fern

Polystichum neolobatum - long-eared holly fern



Phyllitis scolopendrium

Photo courtesy of Arlen Hill

GROUND COVER FERNS

Adiantum venustum - himalayan maidenhair

Blechnum penna-marina - alpine water fern

Blechnum spicant - deer fern

Gymnocarpium - oak fern

Matteuccia struthiopteris - ostrich fern

Onoclea sensibilis - sensitive fern

Thelypteris decursive-pinnata - japanese beech fern

Woodwardia areolata - netted chain fern

FERNS FOR CONTAINERS

Adiantum aleuticum - western maidenhair fern

Asplenium scolopendrium - hart's tongue fern

Asplenium trichomanes - maidenhair spleenwort

Cyrtomium spp. - holly fern

Dryopteris affinis - scaly male fern

Dryopteris erythrosora - autumn fern

Dryopteris lepidopoda - sunset fern

Osmunda regalis - royal fern

Polystichum setiferum - soft shield fern

Polystichum tsus-simense - korean rock fern



Polystichum tsus-simense

Photo courtesy of Arlen Hill

VERY COLD HARDY FERNS

Adiantum aleuticum - western maidenhair fern

Asplenium trichomanes -maidenhair spleenwort

Athyrium filix-femina - lady fern

Athyrium niponicum 'Pictum' - japanese painted fern

Osmunda spp.

Polypodium vulgare - common polypody

Polystichum acrostichoides - christmas fern

Polystichum braunii - braun's holly fern

PACIFIC NORTHWEST NATIVE FERNS

Adiantum aleuticum - western maidenhair fern

Adiantum aleuticum 'Subpumilum'

dwarf western maidenhair

Asplenium trichomanes - maidenhair spleenwort

Athyrium filix-femina - lady fern

Blechnum spicant - deer fern

Cryptogramma acrostichoides - parsley fern

Dryopteris arguta - coastal shield fern

Dryopteris expansa - northern wood fern

Gymnocarpium - oak fern

Polypodium amorphum - mountain polypody

Polypodium glycyrrhiza - licorice fern

Polystichum andersonii - anderson's sword fern



Athyrium niponicum 'Pictum'

Photo courtesy of Sue Olsen

Collecting and Cleaning Spores

A. R. Matt Busby, Director
British Pteridological Society Spore Exchange
Coventry, England

Collecting fern spores is a relatively straight forward task as long as a few simple rules are followed. Normal species usually provide normal spores which, when grown on a suitable compost and given a little warmth and light, will germinate readily. Most hybrids produce abortive spores which will not germinate. Hybrid spores are easily recognized. If they are examined at around 100× magnification they will appear white and somewhat wizened. Healthy spores have a uniform shape, often round or similar to the segments of an orange. They will vary in color according to species: i.e. yellow, black, brown or green.

Spores of Garden Ferns

Hardy ferns in temperate gardens usually produce their spores from June onwards. When the spore cases are ripe they will appear light brown and often show the color of the spores inside – *Polypodium* = yellow, *Athyrium* = black etc. Another indication that the spore cases are ready is that the protective scale, the indusium, will have lifted, withered or completely disappeared to give the spore cases room to dehisce. A hand lens, preferably with a 20× magnification, is useful for checking the condition of the spore cases on the frond. Remember, if the spore cases have a ragged appearance and /or if there is lack of spore color, the spores have probably already dehisced.

In most cases two or three pinnae will provide an ample quantity of spores to sow. Simply place the pinnae in a paper envelope (or a securely folded sheet of clean white paper) and keep it somewhere warm and dry for a day or two. Never use polythene bags as any trapped moisture will delay or even prevent the spore cases dehiscing. After a day or so give the envelope (or the folded paper equivalent) a few flicks with a finger to ensure that the spore cases have opened and that a dusty deposit, including the spores, has dropped. The pinnae themselves can be discarded. If there are no spores then the pinnae were either picked too late and the spores have gone, or too soon.

Indoor Ferns

The spores of tender indoor ferns are available almost all the year round, although during the short days of winter fewer fronds are produced. Nevertheless, the technique for collecting hardy fern spores applies equally to indoor ferns.

Cleaning Spores

I do not consider it essential that spores are separated from other sporangial debris, but it is highly recommended as there is always the possibility a contaminant may be introduced and cleanliness is going to increase the chances of a successful spore

sowing. To clean the spores brush (I always use an artist's natural bristle paint brush) them onto a sheet of any non-shiny paper (not plastic as any static electricity present will render the spores uncontrollable). Slowly tip the paper on edge and tap it gently. The heavier sporangial debris will fall off the paper while the much smaller and lighter fern spore will adhere to it. A small quantity of spore may be lost but what is left will be more than adequate for most needs. Next, carefully fold the paper in two and tap gently. This traps the spores along the crease. To sow them, gently brush a small quantity onto the surface of the compost.

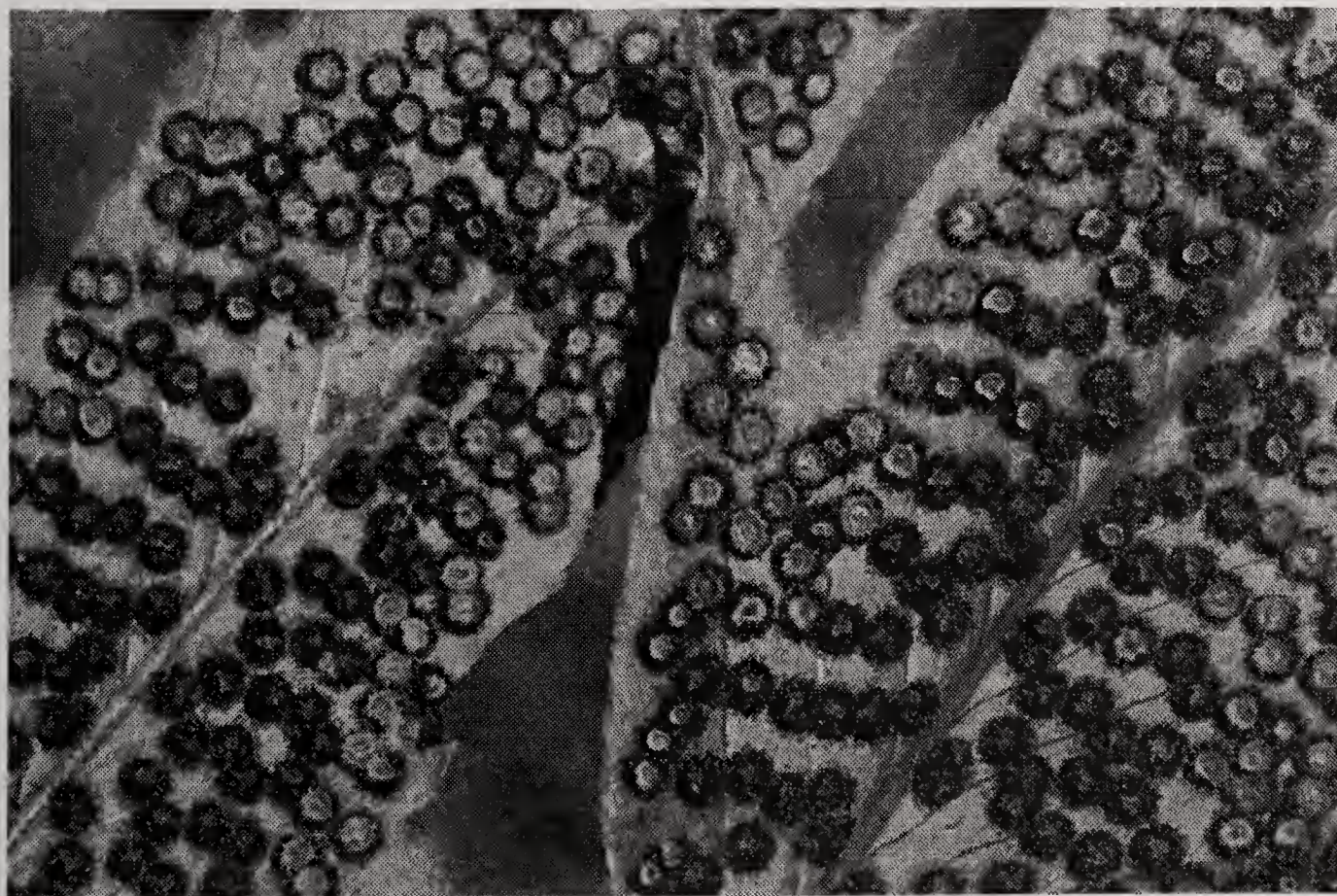
The Longevity of Fern Spores

The longevity of fern spores is often discussed between growers and involves much speculation rather than hard fact. Certainly, green spore from such genera as *Osmunda* and *Ophioglossum* have a very short life, perhaps a matter of only a few days to a few weeks. However, I often supply spores of *Osmunda* to various parts of the world by airmail post and have never received any complaints concerning lack of germination. The spores of other genera may remain viable for weeks or perhaps even years. I recommend that we ignore all of this and obtain spores as fresh as possible and sow immediately.

Storing Spores

I have one recommendation on this – DON'T! Fern spores are much better off on the surface of the compost rather than languishing in an envelope. Of course, spores from spore exchanges have to be stored and spores that are not likely to be sown immediately benefit from refrigeration, but the viability rate increases noticeably with prompt sowing.

May you find delight and success in the spore growing experience.



Cyrtomium macrophyllum

Photo courtesy of Arlen Hill

How to Propagate Ferns

Sue Olsen
Bellevue, WA

Many enthusiastic fern gardeners wanting an ever increasing number of ferns eventually succumb to the urge to propagate. To create large numbers of young ferns spore propagation is generally the option of choice. To duplicate existing ferns, building up numbers somewhat slowly but surely, vegetative methods are practical, faster and definitely more consistent and reliable.

Vegetative Propagation

The two main types of vegetative propagation are quite different. Bulbils or buds produced on fronds may germinate with or without intervention by the gardener. Propagation by division, on the other hand, is totally dependent on assistance from the grower.

Bulbils

True to its name, *Cystopteris bulbifera* has bulbils – pea sized - randomly distributed on its fronds. These will drop and reproduce without human assistance. Others, most commonly on assorted polystichums, cling more tenaciously to the fronds and benefit from some judicious midwifery. When there are just one or two bulbils such as on *Polystichum andersonii*, I peg the frond tip down on surrounding soil in the fall and let nature take its course. However, for the rare bulbiferous sterile hybrids, such as *Polystichum* × *dycei* I recommend pampering. For these I remove the bulbils from the fronds and pin them on the moist surface of a light compost in a 4" pot and invert a clear plastic cup on top creating a personalized greenhouse which is then placed under cool white fluorescent lights.

I use a different procedure with the *Polystichum setiferum* cultivars. Here we have masses of would be plantlets lining the rachis (main stem). Often I pin the entire frond down on friable soil leaving it attached to the parent plant, however sometimes, for greater speed, I place the pregnant frond on a flat of light compost, again under fluorescents. The babies will sprout quite promptly.

Finally, for yet another vegetative propagation situation, there are the mother fern types where the babelets actually grow on the fronds. *Asplenium bulbiferum* and *Woodwardia orientalis*, for example, all have such buds looking like miniature winged darts on their foliage. Prick them off and line them up in flats with a plastic dome or as described above in pots capped with plastic cups, and place under lights. Rooting and new growth follow very quickly.

Note that with any propagating procedure carried out in an enclosed system, it is very important to gradually harden off the progeny by slowly exposing them to increasing amounts of non incubating air and reduced humidity. Open the container in increments and keep a watchful eye out for wilting.

Division

Division is a practical option for increasing two types of ferns – those with a creeping and/or branching rhizome and those with multiple crowns. Ferns with creeping rhizomes can be judiciously cut apart, taking a growing tip and roots, and potted up in humusy soil or, if of substantial size, set directly into the garden. Try for four inch or even larger clumps as many species, such as *Adiantum venustum*, do not like to be pried into small bits. I prefer to do this with a sharp knife or spade in the fall but gardeners in areas with harsh winters operate in the spring enabling the roots to reestablish during mild weather. Do this with the long creeping polypodiums, gymnocarpiums, thelypteris, some woodwardias and those masters of long rhizomes, dennstaedtiads. In practice the same technique works well for the short creeping clump forming types including cheilanthes, some adiantums and the popular *Athyrium niponicum* 'Pictum'. Post surgery, all divided ferns benefit from having a percentage of their fronds removed to reduce stress.

Stoloniferous ferns with rhizomes on steroids, such as the ostrich fern, *Matteuccia struthiopteris*, will happily colonize with new plants appearing at some distance from the parent. These can be dug as individuals and easily reestablished (or graciously given away to a friend in need of instant landscaping.....the gift that keeps on giving).

Surgery of another sort is used to divide ferns with multiple crowns. Many dryopteris develop offsets most easily observed when the fronds are removed. These are complete circles of coiled crosiers and each offset can be separated from the parent to produce a new plant. As these divisions can be quite substantial in size a good sharp spade or machete sized blade are the recommended weapons. I usually carve away offsets from the plant's perimeter being certain to include a generous portion of root material. Again in mild winter areas, fall is an ideal time and for cold areas, before new growth in early spring. Incidentally, left undivided, these same, multi crowned plants can form massive specimens that are incredibly handsome so choose wisely before taking knife in hand.

Spores

Although the average gardener looking for a few new ferns is rightfully happy with the season's crop at the local or mail order nursery, the truly addicted eventually turn to growing their ferns from spores. Despite its reputation, spore propagation is not particularly difficult, but it does take time to produce a mature plant.

Spores are like fine powder and waft about like smoke. "Do you have an indoor fern that won't drop dust on my piano?" queries a customer. Sorry....but these are the spores which are in sori and usually, but not always, on the underside of the fern frond. With no flowers, and consequently no seeds, ferns have a unique alternation of generations life cycle, the sporophyte and gametophyte. Our familiar foliar garden fern is the sporophyte which when mature produces the spores, millions of them. The spores germinate and form the gametophyte generation with small, tissue thin structures known botanically as prothalli. These contain an archegonium sheltering a single egg and antheridia housing the sperms. When mature and assisted by moisture the sperms swim toward the egg and fertilization takes place. Shortly thereafter the "true" fern, or sporophyte, emerges completing the cycle.

Spores can be yellow, green, brown or black and their soral arrangement is of easy observed, botanical significance in determining differences among fern genera. The truly primitive ferns, such as the osmundas, carry their (green) spores in specialized structures separated from the foliage. When ripe they are dispersed practically simultaneously. Over the millennia, as competition increased in the plant kingdom, ferns became more circumspect and the sori moved to the frond's underside. As they became even more sophisticated the sori developed a fine membrane, known as an indusium, which covers the sori and lifts up when the spores are ripe. Thus protected, these evolutionary sophisticates gradually release their spores from the pinnae at the bottom of the frond to those at the apex and from the rachis outwards efficiently dispersing the spores over a longer period of time.

Growing your own

For every grower there are slight to significant variations in approach. They range from sowing spores on expanded peat pellets which are pretreated with boiling water to assorted modifications of the method described below. If you are successfully propagating, skip on to the next article!

The whole process starts with the spores. Most garden spores mature between May and October with the adiantums being among the last. *Onoclea sensibilis*, matteuccias and some woodwardias are among the exceptions that can and do hold their spores until the following spring. With practice, sometimes painful, the grower can choose a frond at the optimum time for collection.

For collecting and cleaning information see the related article by Matt Busby

Once cleaned the spores are now ready for sowing. I find it best to sow the spores when fresh. With osmundas and other species that have short-lived, green spores it is essential to sow immediately. They are viable for about three weeks although freezer storage may prolongs their viability. (Spores of any ferns that will not be used immediately benefit from refrigeration.) Blechnums, while most are not of the green variety, can be temperamental subjects and are most likely to produce a successful crop when promptly sown. For beginners and those eager for immediate gratification, I recommend starting with almost any of the dryopteris as they consistently germinate with ease. The xerophytic cheilanthoids whose spores are so exuberant after finding themselves on a moist medium are marvelous for instant greenery (if not long term ease of cultivation)!

I use rigid, clear plastic containers, approximately 4" by 5" by 2 1/2" high which I recycle and sterilize by running through the dishwasher - on the top shelf please - away from the heating element. Containers, that can be firmly sealed, say from the salad bar of the local grocery store are an inexpensive one use option. For a medium, and here where there are multitudes of options, I use a commercially packaged earthworm compost that is primarily a mixture of humus with some peat and small bits of perlite. I place this in a lasagna pan and pasteurize it by lightly moistening but not soaking the soil. I cover but do not seal it, with foil and bake at 175°F (64°C) for three hours. Hotter temperatures destroy the good as well as the bad in the soil mix. Be advised it has an earthy fragrance and can scare off dinner guests. Other growers use their microwaves for sterilization. However, since there are so many variables, I cannot safely give

formula. Finally, for a simpler procedure pour boiling water through the soil being certain to “cook” the entire batch and noting that it may take some stirring and several immersions to sterilize thoroughly.

Once cooled I place a ¾” layer of moist soil in my clean containers and proceed to dust the spores on the surface. To prevent contamination when doing more than one culture, I start with the packets that have the least amount of material and I also do each sowing in a different room. The containers go on shelves approximately 12” under cool white, fluorescents that are turned on for 14 hours/day. There is no need for fancy or expensive light tubes. Throughout the entire procedure the cultures must be out of direct sunlight although indirect light such as a north window is fine. Commercial growers leave lights on longer, sometimes up to 24 hours/day and replace bulbs frequently to produce a maximum output of consistent light. In addition their controlled temperatures maintained at 65-70° (18-20°C) are clearly beneficial but not necessarily practical for the home grower. I must confess, however, that the professionals routinely produce an admirably uniform and attractive finished product very efficiently.

In time, perhaps as soon as several weeks, a thin green haze will form on the culture. This will expand into a carpet of prothalli. When individual prothalli are approximately ¼” they should be lightly misted to encourage fertilization. Beware of overcrowding as the sperms, but not the eggs, will develop and fertilization will consequently not be possible. Meanwhile, if no little sporelings appear after several additional weeks, and the culture has a uniform distribution of prothalli, spritz again. Some growers recommend using distilled water but I have found normal tap water, which has settled overnight to release the chlorine, to be just fine. An exception would be if the local water is naturally alkaline in which case it could kill or at least curtail growth on acid loving species (especially blechnums).

Meanwhile, with or without budding sporophytes, I move small clumps, not individuals, of prothalli/sporelings to 72 celled trays in a covered “mini greenhouse” in a mix of peat, washed grit and composted potting soil. They remain under fluorescent lighting until they are about one inch tall. At that time I harden them off by gradually lifting the lid of the pseudo-greenhouse.

From there they are transplanted into pots with a soil mix of compost, peat and well-washed grit or pumice (with the washing extremely important for removing the fines that are chalk like and can plug the vital oxygen pockets in the soil). Do not overpot as the soil that is not quickly penetrated with roots will drain poorly and sour in short order. A 4” pot provides ideal room for rooting. When the fronds reach four to six inches the pots are ready to be transferred out to a cool lath or shade house, depending, of course, on the season. Elapsed time can be from 8 to 12 to 24 months or longer. Arachniodes, athyriums, aspleniums, cyrtomiums, dryopteris and certainly doodias and pteris are a sampling of reliable choices for reaching respectability in 12 to 18 months. Polystichums are erratic ranging from prompt to long term but reliable. Blechnums and polypodiums are slow. (And pyrrasias are about the slowest on the planet.)

There is a rather odd bit of botanical magic that takes place with some species, especially those from dry areas where fertilization is challenging, and this is a process

called apogamy. Essentially without going into botanical detail these ferns skip the sexual requirement and go directly into sporophyte production. It saves the propagator lots of time and trouble. Approximately five to ten percent of the world's ferns are apogamous including many *Dryopteris*, *Cheilanthes* and *Cyrtomiums*.

As with any system, there are, of course, potential problems. In spite of precautions, algae or molds may develop on the surface of the culture, especially when there are only a few prothalli rather than a solid covering. A light application of diluted fungicide (the old standby Captan is fine) can bring this under control. Fungus gnats are obnoxious, but not fatal. A light spray with an insecticide keeps them under control. Oil based sprays are not appropriate for ferns and I have also had disasters with soap based formulas. Resmethrin which is a component of many commonly available commercial products is a safe and effective option which will also control aphids, and a number of other pests.

Cultivars

Cultivars are deviations from the type species and present assorted variations in frond and/or pinnae shape, degrees of dissection as well as assorted flourishes on the frond tips. They are especially common on *Athyrium*s, *Phyllitis*, some *Dryopteris* and *Polystichum*s. For propagation purposes some come true from spores, but many others produce inferior imitations.

Hybrids

Hybrids are possible between two closely related species and are common in some genera such as *Dryopteris* and *Asplenium*. Traditionally they are quite vigorous, often out performing their parents. Due to their chromosome composition, however, they are frequently sterile - look for spores that are misshapen or shriveled. These must be reproduced by division or, as is becoming increasingly common, tissue culture.

Tissue Culture

A number of commercial growers have developed a laboratory technique for producing great numbers of progeny via a process that involves selecting a meticulously cleaned and sterilized growing portion of the fern or spores and putting it (them) in a customized nutrient solution. This results in a multitude of plantlets that are rapidly grown on in test tubes until they are strong enough to survive as individuals. Thus one plant can produce huge numbers of young in a short time. It also is a promising and successful way to reproduce sterile hybrids, cultivars and other ferns that are difficult to impossible to raise from spores. It has not yet developed into a practical system for the home propagator, however, as the antiseptic conditions are extremely difficult to duplicate.

Happy growing.....

The above recommendations are excerpts from *The Encyclopedia of Garden Ferns* Timber Press 2007.

1859 And All That

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Biologists are celebrating 2009 as the 150th anniversary of Charles Darwin's *On the Origin of Species by Means of Natural Selection*, widely regarded as one of the most influential science books ever published. You may well retort: "So what!" and then ask how Darwin's work from 1859 has any relevance to the present interests of HFF? In fact, there's quite a lot of relevance. Winter freezing, summer drought, and slug attack would have been recognized by Darwin as 'environmental selection pressures' that determine 'survival of the fittest', one of the central themes in the *Origin*. However, whether variation-coupled-to-fitness provides the main engine of evolution, as Darwin believed, is still controversial.

A major difficulty is finding evidence that distinguishes *survival of the fittest* from *survival of the luckiest*, the two frequently going together. The *luckiest* are those members of a population which, purely by chance, escape the diverse life-ending threats of daily existence. The *fittest*, on the other hand, are those individuals that, in addition, have some useful feature that allows their better survival amid the fatalities of those that lacked this feature. 'Survival' in both cases implies staying alive at least until reproductive age.



Figure 1. Grove containing dead and alive specimens of the South African tree fern *Cyathea dregei*, at Logan Botanic Garden in Southwest Scotland. All the plants in the circular beds are of this species, except those in the larger bed at left-centre which are blechnums.

Figure 1 poses a question for Darwinians: does the scene illustrate *survival of the fittest*, or *survival of the luckiest*? In other words, did the different individual *Cyathea dregei* tree ferns actually vary in winter-hardiness, some being *fitter* than others - in withstanding cold conditions? Or, was the planting area not as uniform as it seems, allowing luck or chance to deliver fatal experiences, such as localised cold winds, to some

plants but not others? The grass of the lawn looks no different in the vicinities of either the dead or the living tree ferns. But were there subtle environmental factors killing some of the tree ferns and not the rest?

The *C. dregei* at Logan had previously been grown at the Royal Botanic Garden Edinburgh (RBGE) from spores collected at high-altitude in the mountains of South Africa. After several years of indoor cultivation, the ferns had started to develop trunks and were outgrowing the space available under glass. They were then transferred as a batch to Logan Botanic Garden, an out-station of RBGE, to form the centre-piece of the decorative planting illustrated in Figure 1. So it was not a planned hardiness trial, as such. Rather, it was more a display and demonstration of what can be grown in this garden which is famous for its tender exotics. At the time I took the picture, in the summer after the second winter, the *C. dregei* area looked rather forlorn, with some of the specimens no more than dead trunks. For winter protection, they had all been individually wrapped with burlap and straw.

One (highly impractical!) suggestion for investigating possible differences in the fitness, or hardiness, of the individual *C. dregei* would have involved tissue culture done ahead of the outside planting. Thus if each of the Logan specimens had been cloned in tissue culture *beforehand*, there would have been multiple live copies both of the dead plants in Figure 1, as well as of those that survived. Representatives of the dead and alive categories could then be trialled for hardiness, in good numbers and side-by-side in different parts of the Garden. This should reveal if indeed there were genuine differences in winter-hardiness. An alternative is that the shown differences in Figure 1 were purely due to chance, or luck, in the environmental experiences at the different micro-sites. Whatever the explanation, at least we now know that *C. dregei* can be planted outside in this mild region of Scotland, with a good chance of survival. However, future *C. dregei* sites should probably be planted with shelter-bushes, maybe sacrificing some of the aesthetics. Also, despite the winter-wrapping, some losses would



Figure 2.

Dicksonia antarctica mingled with eucalyptus at Logan Botanic Garden.

be likely.

A marked contrast with *C. dregei* is provided in another part of Logan BG where a grove of the Australian tree fern *Dicksonia antarctica* has been established (Figure 2). This species is generally considered to be the hardiest and most reliable of the tree ferns for outdoor planting in Britain, an impression supported here by the absence of dead trunks. Note, however, that a direct comparison of hardiness with *C. dregei* would be unfair, since the *D. antarctica* is in a more sheltered site, due to the inter-planting with eucalypts and the surrounding woodland.

A back issue of this Journal [Summer 2002, Vol. 12(3), p.75] contained the Garden Evaluation from Georgeson Botanical Garden in Fairbanks, Alaska. This reported that whereas 4/4 *Matteuccia struthiopteris* were alive in 2001, the result for *Dryopteris fragrans* was only 1/10. Speculation, therefore! Did the one survivor among the *D. fragrans* differ in actual hardiness from the 9 that perished? Or, by chance of favourable micro-site, did the solitary survivor happen to escape (i.e. luckiness) the environmental experiences that had done-in the others?

This type of question is familiar to all gardeners confronted with less than 100% success after a planting operation. Only rarely is there a convincing answer. One point for more emphasis is the benefit of reporting each planting as the ratio # Alive Now / # Initially. Thus if the Georgeson report had simply stated that in 2001 the Garden had one plant of *D. fragrans*, this would be not nearly as interesting as the recorded 1/10, indicating a 90% kill. Such high losses are especially intriguing, as *D. fragrans* is an Alaskan native and one wonders why there was a problem. I noted that none of the other 6 Garden Evaluations in that issue of HFFQ listed *D. fragrans* among their holdings, although there were plenty of other *Dryopteris* species from North America. Sue Olsen in her *Encyclopedia of Garden Ferns* describes *D. fragrans* as 'particular and fussy' and 'requires that magical ingredient, drainage'. This agrees with my own score of about 1/20 in trying to grow *D. fragrans* in Scotland, even knowing about the drainage. I suspect there may be other 'magical ingredients' to meet the needs of this species.

To display hardy ferns in attractive settings is a different objective from running actual hardiness trials on particular species or varieties. Nevertheless, if the *survival ratio* '# Alive / # Initially', rather than simply '# Alive' on a particular date is reported, then better information is generated. Such reporting should also include ratios such as 0/10 where there was a total wipe-out.

At the other end of the 'happiness' scale, from the fern point of view, is when the site not only allows 100% survival, but also enables the fern to reproduce from its own discharged spores germinating in the ground nearby. I am very conscious in my garden that very few of the fern species and varieties, whether native or foreign, are able to spread by spores, although the mature specimens survive indefinitely after planting-out from pots. There are, however, a few British natives such as *Asplenium scolopendrium*, *Athyrium filix-femina*, and *Dryopteris affinis* which pop up as 'weed ferns' almost everywhere (Figure 3). However, most other native species, such as *Osmunda regalis*, have totally failed to spread themselves by spores during the 38 years we have lived here. They have, of course developed multiple crowns and many ferns have also spread by creeping rhizomes.

Hardy foreign ferns planted in a garden may have phyto-sanitary implications if they develop into *invasive aliens*. We should perhaps ask routinely what risks there are

in bringing in a foreign species of fern that might become invasive? Florida, for example, has a considerable alien-invasion problem with the introduced *Lygodium microphyllum*. According to the web, Hawaii has 33 species of naturalised pteridophytes in its flora, including the Australian tree fern *Cyathea cooperi* which has become a serious pest in the forests. With my collection, the answer to the alien-risk question would have to be both 'yes' and 'no'. Of the North American species in the garden, those that have spread by spores and are potentially therefore in the 'yes' category include *Onoclea sensibilis* and *Polystichum munitum*. But they are also in the 'no' category through already having been recognized for many years as naturalised but unthreatening aliens in the British flora. Nevertheless, in Darwinian terms, they are sufficiently 'fit' to win the local 'struggle for existence' by inserting and propagating themselves in the wild. Although showing no signs of developing into new species in Britain, the *Polystichum munitum* has hybridised in the wild with the native *Polystichum setiferum* to give the new taxon *Polystichum x lesliei*.

The only alien fern considered a pest in Britain is the water fern *Azolla filiculoides*. It can carpet the surface of ponds and canals, leading to unwanted ecological consequences.



Figure 3. Centre: Numerous *Asplenium scolopendrium*, a variant with mildly fork-tipped fronds, which have spread themselves as 'weed ferns' through spores settling in rockery crevices and growing into mature plants. Top left: *A. scolopendrium* 'Bolton's Nobile', a crinkled variety with only sterile fronds and which therefore does not spread by spores. Bottom right: 'fern weed' specimens of *Athyrium filix-femina*, spread by airborne spores from nearby sources.

The mildly fork-tipped variant of *A. scolopendrium* in Figure 3 raises a relevant point about 'survival of the fittest' as applied to *fern variants*. It would seem that, in general, the crested and other variants of ferns, like those in Figures 3 and 4, do not win the Darwinian 'struggle for existence' when matched against the ordinary and uncrested

wild-types. Thus there is little evidence that crestring has delivered extra fitness, in the Darwinian sense, otherwise over geological timescales the crested variants should have become dominant; whereas they haven't. In the 19th Century, during the Victorian Fern Craze in Britain, the crested and other bizarre deviants were and are rarities, among an abundance of the normal uncrested forms. They were found mainly as isolated plants and showed little tendency to spread, other than vegetatively.

Cresting is due (presumably) to mutation of a gene that controls the morphology of



Figure 4.

Osmunda regalis 'Cristatum', with multiple crowns, beside a pool in the author's garden.

Top left has *Blechnum penna-marina* and *Onoclea sensibilis*. Right centre is *Thelypteris palustris*.

frond development. Potentially this could generate the variation on which Darwinian evolution depends. However, the expression of the 'crestring' gene seemingly leads to an evolutionary dead-end and not to the '*Origin of a Fern Species by Means of Natural Selection*'. In fact, I can not think of any fern species whose common wild-type is already crested and which has won the 'struggle for existence' against a hypothetical uncrested ancestor. Instead, the contrary has prevailed.

Gardeners tend to forget that the site where a fern plant grows in the wild is not necessarily where it would opt to grow if it were allowed any choice. We gardeners try to provide a good 'home' in a garden where a cherished pot-grown fern can spend the rest of its days. But this is highly unnatural. The places where ferns occur in the wild are determined by a) where airborne spores (preferably several, to allow cross-fertilization of prothalli) land on the ground or other surface not already occupied, b) where the site is kept continuously moist for weeks or months while the spores germinate, the prothalli develop and where fertilization occurs, and c), further weeks or months of high humidity while the young sporophytes grew into what we would recognize as fern plants. We tend to think of hardiness as applying only to the sporophytes – the plants we most often see and recognize as 'ferns'. But in the wild, the seldom-noticed gametophytes may need hardiness too, unless they complete their life stages during the frost-free months of each year. I know there are a few Japanese papers on this question.

Thus ferns in the wild are like frogs, in having a compulsory aquatic stage in their life cycle, but without the legs to get away from it when they reach maturity. With humans, the corresponding fate would be permanent residence in mothers' arms or cradles – to the detriment of mothers and cradles and, of course, the work of HFF!

□

How to Build a Limestone Cobble

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According to the dictionary a cobble is a rounded hill with embedded rocks (cobblestones?). Many backyards have a spot that can be made into a cobble for “lime-loving” plants that otherwise do not thrive in the garden. There are fern species, especially the little rock snugglers like wall rue (*Asplenium ruta-muraria*) that require the alkalinity (pH 7.5-8) of a limestone ledge, crevice, or mortar joint while others, like mountain spleenwort (*Asplenium montanum*) grow only on acidic rocks like sandstone (pH 5-6.5). Some species are not so much dependent on these special substrates as they are tolerant of the high or low pH that excludes competition from the many plants that are adapted to neutral soils (pH 7).

Survey your property for a north-facing site with a slope that rises about one foot for every three feet of length, preferably with seepage from the top that keeps the soil moist to a depth of 4” but not constantly wet.¹ Excellent drainage is essential for most cobble plants. It is also important to have dappled shade from small trees and shrubs like striped maple (*Acer pensylvanicum*), sassafras (*Sassafras albidum*), bladdernut (*Staphylea trifolia*), spice bush (*Lindera bendoin*), shadbush (*Amelanchier* spp.) and chokeberry (*Aronia* spp.). Plants cited in this article are from the writer’s experience with northeastern species in growth zone 5-6. Readers in more southern or western (especially desert) locales should substitute species native or successful in those areas.

●In the fall, **dig the soil in the cobble area** to a depth of at least 6”, eliminating weeds, underground rhizomes, and debris. Mix in as much compost as possible, and, **if the soil is not naturally alkaline** (pH 7.5-8), add small limestone chips, marble dust, crushed eggshells, pelletized lawn lime, or any similar soil amendments that raise the pH of the soil. Local building supply centers, stonecutters or sculptors may be a good source for some of these materials. About ½ pound of a lime source per square foot is usually needed to amend neutral or slightly acidic soils. Garden centers sell various devices for testing soil pH or it can be done by an agricultural extension service.

●**Rake the surface** smooth and “plant” a variety of small to large limestone rocks or chunks of mortar in clustered arrangements that create planting areas with good eye-appeal and some elevation for topographic interest. Be sure to set the rocks firmly into the ground to avoid frost heaving if that is a problem (particularly in growth zone 5-6). This is also a good time to install a drip irrigation line if the cobble site lacks natural seepage. Then leave the cobble to settle, condition, and establish a stable moisture pattern over the winter.

●The following spring **introduce lime-loving plants**. Start with fern species that are relatively easy to grow like blunt-lobed cliff fern (*Woodsia obtusa*), bulblet fern (*Cystopteris bulbifera*), northern maidenhair (*Adiantum pedatum*), European and North American male ferns (*Dryopteris filix-mas*), and ebony spleenwort (*Asplenium*

platyneuron). Add flowering species like blue-eyed Mary, celandine poppy, yellow lady's-slipper, and twinleaf. These can be purchased from nurseries that specialize in wildflowers and should not be removed from the wild. Plantings are best grouped at the base of rocks and in rock crevices. Nestle them into ledge cavities or vertical cracks using fibrous compost or mats of moss to wedge the roots gently. Unless there is adequate rain or seepage, water twice a week keeping the ground moist to a depth of 4" until new plantings are well established. It is a good idea to give small rock garden plants more space and soil in the cobble than they occupy in the wild.

●As your experience level increases, more refractory **future additions** might include the diploid European hart's-tongue fern (*Asplenium* [*Phyllitis*] *scolopendrium* var. *scolopendrium* or "Scollies" in British parlance). There are literally hundreds of described varieties of this elegant fern whose simple leaves and auricled bases have been embellished by mutation into a dizzying array of crested, crisped, undulated, spiraled, and other cultivars. They are not all equally vigorous or hardy, so beginners are well advised to start with the standard "wild" type and add others as confidence builds. Consider adding some plants of the rare, tetraploid American hart's tongue fern (*Asplenium*. [*Phyllitis*] *scolopendrium* var. *americanum*). It is easy to grow from spores,² occasionally available from the HFF Spore Exchange.

Other ferns to consider for the well-established cobble are walking fern (*Asplenium* [*Camptosorus*] *rhizophyllum*), limestone oak fern (*Gymnocarpium robertianum*), purple and smooth cliff brakes (*Pellaea atropurpurea* and *P. glabella*, respectively), fragrant wood fern (*Dryopteris fragrans*), and mountain male fern (*D. oreades*). Northern holly fern (*Polystichum lonchitis*) is a beautiful alpine and boreal species but needs cool shade in summer and protection from soggy wetness in winter. The low-growing, Asian *P. deltodon* is a charmer, but grows painfully slowly from spores and is not commonly available in the trade. There are species of *Cyrtomium* that grow well in alkaline soils, e.g. *C. fortunei* and *C. caryotideum*, although both thrive in the ordinary garden. Those with deep green thumbs might try hairy lip fern (*Cheilanthes lanosa*) on a sunny rock nest or gamble with choice aspleniums like maidenhair spleenwort (*Asplenium trichomanes*), black spleenwort (*A. adiantum-nigrum*), fountain spleenwort (*A. fontanum*), and the coveted hybrid, Scott's spleenwort (*A. ebenoides*). Sue Olsen's *Encyclopedia of Garden Ferns*³ offers helpful cultural hints for these ferns.

●As your collection grows be sure to **eliminate or tame any rampantly growing flowering plants** or opportunistic invaders. Be mindful that **slugs and snails** are partial to the fronds of many limestone ferns, especially the aspleniums. Each spring, as the ground begins to warm, scatter slug bait, e.g., environmentally friendly, iron phosphate products like "Sluggo," "Es-car-go," and "Safer's Slug and Snail Bait". Slugs also can be killed by copper tape, 2" wide, laid around the periphery of the cobble. Dry, abrasive materials like river sand, pulverized eggshells, and grit work effectively as slug excluder rings, but must be reapplied following rain. In any case slug re-invasions are inevitable and constant vigilance is necessary. An annual (fall) scattering of pelletized lawn lime seems to deter slugs and maintains the cobble alkalinity as its calcium and magnesium slowly percolate into moist soil.

A natural limestone cobble can be seen at **Bartholomew's Cobble**,⁴ near Ashley Falls in southwestern Massachusetts. This National Natural Landmark preserves 250+ acres of old cow pasture and both quartzite (acidic) and dolomite (magnesium-containing limestone) knolls rising to 100' above the Housatonic River. An incredible fifty-three pteridophytes have found a home in the diverse habitats at Bartholomew's, some only occasionally (e.g. Scott's spleenwort). Large colonies of maidenhair spleenwort, walking fern, wall rue, and purple-stemmed cliff brake are guaranteed eye candy along the Ledges Trail. These are among the most difficult species for the cobble gardener so it is at once exciting and frustrating to see them growing with abandon here, neither pampered nor tended. A dozen orchid species thrive as do lilies, lobelias, and gentians (part of 800+ recorded seed plant taxa in the reserve). The limestone here is weathered marble (a metamorphic, crystallized rock), but worldwide, limestone commonly occurs as a soft, layered (sedimentary) deposit, dissolving easily under the erosive action of water carrying CO₂, releasing alkali-forming calcium. This same process forms caves, grottos, stalactites and stalagmites, but also sinkholes and depressions in which plants can take root.

The **Niagara Escarpment** – from its namesake falls in New York on the east, the Door Peninsula in Wisconsin to the west, and the Bruce Peninsula in Ontario's Lake Huron up north – is another natural "cobble". It has limestone bedrock, hardwood (maple) forests, cobbly beaches, offshore islands in Georgian Bay, and vast, sloping, ledge-like outcrops - home to American hart's-tongue and male ferns, slender rock brake (*Cryptogramma stelleri*), and northern holly fern, along with more common calciphiles. The amazing flowering plant flora includes calypso, showy, and yellow lady's-slipper orchids, the latter often in showoff abundance.

Creating a limestone cobble in your own backyard can be a rewarding way to replicate on a garden scale this special habitat for special plants. For New Englanders, a large, man-made limestone cobble can be inspected and enjoyed at the Norcross Wildlife Sanctuary in Monson, MA. It is well worth the short detour south of the Mass. Turnpike (at Palmer) on Route 32 and then left onto the Wales-Monson Road. The 3,000 acres at Norcross also feature a cedar swamp, a pine barren garden, hickory and conifer groves, as well as other "hot" habitats for plants. Leslie Duthie⁵ successfully "synthesized" reliably numerous plants of Scott's spleenwort here in 1989, sowing spores of its slow-growing walking fern parent about a month before adding those of the faster ebony spleenwort parent. Margaret Slossen⁶ was the first to produce this famed hybrid in culture back in 1902. Today's nursery specimens are spore-grown from offspring of a uniquely fertile, allotetraploid colony (having spontaneously doubled chromosomes) found in Hale County, Alabama. Scott's spleenwort, when formed ad hoc in a laboratory or in the wild from chance canoodling of its two parents, is diploid and sterile. Calciphiles, cobbles, and cultures are for botanists and gardeners who love a challenge and an occasional dalliance with some compelling plant species.

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How to Build a Fern Bog

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In January, 2006 a large spruce tree that shaded the east side of the Whitehall woodland garden in Louisville, KY had to be removed. This caused an area next to the fern garden to have sun exposure from about 8:30am until 2:30pm. It was decided to utilize the area by building a bog bed to plant *Osmunda* species and other bog ferns. A literature search was made for recommendations for bog construction before the start of construction.

An oval bed approximately 16 ft. (4.9 m) long by 5 ft. (1.5m) wide was laid out. The bed was excavated to a depth of 16 to 18 inches (40 to 50 cm) and the hole was lined with a plastic sheet. Picture 'Liner Installation' shows the liner as first placed in the hole. Eight holes were poked through the liner spaced about 6 inches (15 cm) apart to provide drainage. Since the ground had a slight slope, the drain holes were placed in the downhill portion of the hole's bottom surface. When building on flat ground, most of the recommendations were that the holes should be evenly spaced along the whole length for proper drainage.



The drain holes provide the important function of preventing stagnation and buildup of salts from water evaporation. The liner was cut to fit the hole shape, leaving about a foot of liner laying on the ground around the hole. This was done to allow for settling of the liner during and after filling. Some authors recommend using a child's wading pool or similar plastic container. It should be at the least 12 inches (30cm) deep. One authority on *Sarracenia* (pitcher plants) recommends that the holes be punched about half way up the container's walls. He also recommends that if a sheet liner is used, several inches of damp sand should be used to cover the holes in the bottom of the sheet before adding the fill. Bog plants need the water table to be very near the plant and its roots at all times. Ferns appear to be more tolerant of drops in actual water level so long as the bog remains wet. *Continued on page 54*



Tunnel at end of
stumpery

Photo courtesy of
Pat Riehl

*Dryopteris
fragrans*

Photo courtesy of
Don Avery



Tufa Wall

Photo courtesy of
Don Avery

Hardy Fern
Foundation
Stumpery
Garden

Photo courtesy of
Michelle Bundy





The original fern table, photographed five years after planting.

This picture first appeared in *Gardening on Pavement, Tables and Hard Surfaces* by George Schenk; Published by Timber Press, 2003. (ISBN 088192-593-4)

Limestone Cobble

Photo courtesy of Joan Eiger Gottlieb



Astrolepis integerrima

Photo courtesy of David Schwartz

Cheilanthes covillei

Photo courtesy of David Schwartz



Most of the recommendations for the fill were for a bog planting which included the carnivorous plants such as the pitcher plant. Sphagnum moss or commercial Canadian peat moss without sand, or with a ratio of one part sand to three parts peat, were recommended. For ferns, it was generally recommended to use sandy soil with substantial amounts of humus such as peat and compost. Several authors recommended using only Canadian peat, claiming that the black material can have significant amounts of lime or salt contamination. One author expressed concerns about organic matter in general and its decomposition products,



recommending adding sand and charcoal, but without specifying the ratio. Several cautioned against using play sand, because of texture, or beach or river sand, as it may contain large amounts of limestone based material or salt. It was recommended to check the sand label to determine source if possible. In my experience, the use of compost from local sources may be questionable since ground limestone is often added to cut down on odor during the composting process. If there is a

question regarding the mixture, a soil test is recommended. A mildly acid, high humus material has worked very well in our bog and is recommended for ferns.

In the end, it was decided to use available organic material supplemented with construction sand and peat moss. The excavation was filled with a mixture of spruce stump grindings, composted wood chips, Canadian peat moss, and sand in a ratio of 2:1:1:1. During the filling of the hole, three feet (90 cm) of soaker hose was placed about one foot (30 cm) deep in the uphill area of the excavation. The bed was heavily watered every three or four days and allowed to settle for about two weeks before planting started. No fertilizer was added.



It is important to keep the bog sufficiently narrow so that weeding can be easily done. The Whitehall bog is 5 ft. (1.5m) in width and cannot be weeded in the center from outside the edge. It is necessary to lay 2 foot (60cm) long pieces of 8 inch (20cm) wide fiber board about 10 inches (25cm) into the bog to use as knee supports to weed the center. Slate or ornamental stepping stones make handsome additions and foils for the ferns. (*However, they do not serve comfortably as kneelersEd.*) Probably 4 feet

(1.2m) is about the maximum bed width that could be weeded easily from the edges.

Picture “June 9, 2007” shows the bed shortly after initial planting in early June, 2007. The planting consisted of a mixture of ferns and flowering wetland plants. Two mature *Osmunda regalis* var. *regalis* were moved from the garden to the bog. The other plants, except for the *O. claytoniana* in a gallon pot and the *Woodwardia areolata* as rhizomes, were all growing in four inch (10cm) or smaller pots purchased from various sources. A wire fence was put around the bog as one concern about a bog in a public garden is preventing people from stepping into it unknowingly.

The bed was watered every five days unless a substantial rain occurred. The soaker hose was allowed to run for about twenty minutes after water was observed running from the far end of the bed from the soaker hose. The runoff procedure was adopted to make sure that the bed was flushed of any build-up of mineral deposits from evaporation, as well as any byproducts of organic decomposition. To date, no problems with either have occurred.



The pictures ‘July 29, 2007’, ‘June 3, 2008’ and ‘Aug. 5, 2008’ show the significant growth of the plants in the bed. The *Osmunda regalis* var. *regalis* were five years old when replanted and were about 30 inches (75 cm) tall. They are now over four feet (1.2m). The *O. cinnamomea* and *O. regalis* var. *spectabilis* were 18 inches (45 cm) and 12 inches (30cm) tall respectively. The *O. cinnamomea* are now over 32 inches (81 cm) and the *O. regalis* var. *spectabilis* are now over 26 inches (66 cm) tall. It is interesting that these *O. cinnamomea* are taller, in the second year after being planted, than any plants grown over the years here by me in a garden setting with normal water and shade. The *Osmunda claytoniana* was planted on the margin of the uphill side of the bog on a hummock to simulate its natural habitat on hummocks. It has gone from a floppy fern in a gallon pot to an erect plant over two feet (60cm) tall. A friend donated two sizable pieces of *Woodwardia areolata* rhizomes from her garden. This is now a clump about 33 inches (84 cm) tall at one end of the bog. This is taller than the 28 inches (70cm) given as the maximum for this species by a number of authors. As a trial, two small *Dryopteris cristata* and one *D. celsa* were planted. All are doing very well in spite of the competition from the plants around them. They seem to enjoy the company and shade of the taller flowering plants near them during the late spring and summer. These *D. cristata* are the only ones that have lived longer than one year in this area for me.

Flowering plants add a great deal of interest to the bog garden. *Lobelia cardinalis* makes a striking addition to the planting. It seems to prefer the bog margin. The *Asclepias incarnata* is over seven feet (2.1 m). Its garden size is given as two (60 cm) to five feet (1.5 m) in several references. *Iris fulva*, *Liatris spicata* and *Spiranthes odorata* are all growing well. They bloomed heavily this year and are showing good foliage growth. Care should be taken though to not plant material that might become weedy. The *Rhexia virginiana* which blooms nicely has become very invasive and will be removed. The *Asclepias incarnata* has been dead headed as it resulted in a significant number of plants that had to be removed.

This summer it was decided to expand the bog, remove the wire fence and replace it with a log barrier. The start of the log barrier is shown in Picture 'Aug. 5, 2008' at the lower right side. The expansion will add additional area for ferns such as *Dryopteris clintoniana*, *D. ludoviciana* and *D. carthusiana* as well as making provision for a larger hummock area to grow more bog margin plants. Finally, we hope to successfully grow *Lygodium palmatum* and *Sarracenia* by adding a strongly acid bog area.

Building the bog has been an interesting and rewarding experience. The difference in growth habit it makes available to ferns like *Osmunda regalis* and the other bog lovers is astounding. I recommend adding one if possible.

Ed. note – Visitors to the Hardy Fern Foundation's primary test site at the Rhododendron Species Botanical Garden in Federal Way will find a pond side bog which features many of these ferns.



Stumped

Pat Riehl

Seattle, WA

I wish I could remember when the idea of building a stumpery popped into my head but I can't. It had to have been at least three years ago. My husband and I had been looking for property of three to five secluded and quiet acres. Two years ago we bought six acres of land on Vashon Island, a short ferry ride from Seattle. When I saw the land I knew this was a place where I could build a stumpery. There is a small house, land with a gentle slope, areas with full shade and areas with full sun. It had it all. The next hurdle was researching stumperies because there is not much written on the subject especially in the U.S. I did some web searching and found some information but not a lot. And of course any photos don't do justice to how stumperies should look. I bought three books, two on Highgrove and an old copy of a book on Biddulph Grange. All were places with stumperies so I at least had a start.

My fern interest led me to Sue Olsen, Richie Steffen and Judith Jones. They were looking forward to a trip to Germany sponsored by the HFF and BPS in June of 2006. I was lucky enough to tag along. It was a magical trip for me. I met many wonderful people, who welcomed and taught me about ferns. The next year I was even luckier to have a chance to tour the UK in August with Naud and Wim Burnett and Sue on a ferny excursion led by Martin Rickard. The highlights included visits to the stumperies at Highgrove and Biddulph Grange. Being able to walk into these finally gave me some idea of what I envisioned and what I would be undertaking.

I led a charmed life. Since Martin was coming to the U.S. for another HFF/BPS sponsored tour, this time in Texas, in October of 2007, I asked him if he would consider coming to Seattle to design my stumpery. I couldn't believe it when he said, "Yes". And now the real work began because I had about one month to prepare the site. It was a weed lot of blackberry, stinging nettle and things I had never seen before plus *Polystichum munitum* and a number of old felled, moss covered trees. I saved the tree trunks and the ferns.

Overwhelmed in September

The area I picked for the stumpery is a shallow gully measuring about 9,000 square feet. We cleared the land without using herbicides, felled some alder trees and put down a thick layer of compost. The compost was not dug into the soil because the backhoe would mix it in as it placed stumps. I also learned to call stumps, rootwads. Rootwads is a term most timber people understand and is closer to what is needed since it is the root segments that one wants. Gotta have the lingo. Believe it or not rootwads are not that easy to acquire. To be cost effective try to find a contractor who does land clearing and has dump trucks, backhoes and the rootwads - one stop shopping. Again I was lucky. I found just such a place and on Vashon, too! But be prepared for "the look". "Sure lady, you want what!" After we got past "the look" I was able to secure 50 stumps, a backhoe and an operator. The rootwads are primarily fir (but cedar is desirable as well). All were to be delivered while I was in Texas. You can imagine the relief I had after my arrival

home to see everything there.

Rooted in October

Martin went to work designing. After walking the site and seeing the rootwads he started drawing. I had been able to send him email photos of the site so he had some idea of what to expect. We had also been able to talk during the Texas trip and were very much in agreement about how it should look. My job was to get the biggest wads I could, small would not work. While Martin designed, the equipment operator moved the wads from the driveway to the gully. Martin selected from the wads as he went along, placing and saving certain ones based on size for different locations. He developed a winding path through the bottom of the gully. He placed the stumps in such a way that the top half of the stumpery was concealed from the bottom and also placed a group of very large stumps in the middle of the pathway so that one cannot see along the entire length. The path forks at this grouping giving two exits but neither is seen until one reaches this grouping. Each wad was placed on its own berm to give added height and they tower above those walking along the path. The effect is magnified by Martin's decision to make the entrance to the stumpery start at the lower end of the slope rather than the top so you walk up into the stumpery. The wads appear even bigger. Very clever.

This was all done in two days. It helped to have extra hands ready to jump in and help with things I hadn't thought of such as trimming off all of the small thready roots, compacting the berms, moving compost and cleaning up.

There really is no way to explain how it feels to walk into the stumpery. It is so different from anything experienced before that one has to take the walk like Alice in Wonderland. It is a bit eerie especially now without any ferns or other plants and trees to soften the effect of all the roots going in every direction.

The March of Time

It is now the following March. So far I have planted about 600 ferns, thankfully with help from friends. The stumpery still has an eerie feel to it but with time the ferns will grow and the effect will change. Most of the ferns are commonly available. I will move or take out some as I add rarer types. My planting plan was simple. I planted all of one kind together, most in the berms at the foot of the wads. I have planted them close together but in a haphazard way - not a straight line anywhere. Some ferns, mainly pyrosias and *Polypodium scolopendri* have been planted in the roots. These survived the winter just fine.

The other ferns that survived with help are the eight tree ferns I bought - all *Dicksonia antarctica*. I learned a great deal about tree ferns from Martin and others on our United Kingdom trip. I bought the largest I could, regardless of affordability and planted the trunks about two feet deep (talk about pouring money down a hole). In December, I wrapped the trunks in aluminum foil and garden cloth, then packed the crowns with dry bracken fern fronds, fir boughs and in some cases placed a loose patch of aluminum over the whole mess. All this was taken off in early March, just in time for a snow storm! I continued to water the trunks as best I could by watering below the crown and at the top edge of the foil wrap. It all worked. New fronds are coming. The tree ferns add a

wonderful element to the stumpery. They're not inexpensive nor easy to maintain, but I am glad I made the choice to add them.

The plantings are largely evergreen because I want to see green in wintertime. I also prefer polystichums over dryopteris with some exceptions such as *D. sieboldii*. Planting is a long process. The soil is extremely sandy so I am adding compost to each planting area, mixing it in well, planting, and then adding more compost as a cover. The hope was that all of the compost top dressing would suppress weeds. Here my luck ran out. The weeds love the compost and will be my biggest problem for years to come. Thankfully I enjoy weeding. I also bought a system to burn off the weeds. But I'll use this only in spring. I don't want to burn the whole thing down!

Next

We are now completing a frame work for a stump tunnel to be located at the beginning of the stumpery walk. It measures about six feet long by six feet wide and ten feet tall. This should last long after all the wads and I have turned to dust! I will cover this with wads - she says naively. I found 40 more wads. They were meant to be one or two person wads, but are more like four or five person wads and how to put them on the roof of the tunnel is still a mystery. In addition to covering the tunnel, I hope to use some of the forty to line paths and fill in here and there. In other words 50 wads were not enough for the original work.

Deer are a problem here and we have not added a fence as yet. They don't eat ferns (yet anyway), but they do eat hostas, the perfect companion plant. They also don't eat epimediums which I also love. So I have planted about 125 of these so far. Be advised that the deer will eat the flowers. Luckily the foliage is what I covet. I am experimenting with deer repellent sprays and have sprayed the few hostas I dared plant. So far it is working. So far everything is working. It's magic.

A Year of Reality

Ignorance is such a blessing. The above essay was written a year ago. Things happened! The tunnel is now covered in rootwads. I have planted hundreds more ferns, arisaemas, trilliums, epiphytic rhododendrons, daphnes, rhododendrons, agapetes and more hostas as well as three *Dicksonia fibrosa* and two *Dicksonia squarrosa*. There are no flowering plants other than woodlanders. I did all of this to add texture and diversity to the garden while always trying to remember that the stumps/root wads are the stars and not to be covered over by plants. The other thing I must keep remembering is to keep a simple plant palate. I don't have to have every plant I see. That's the hard part!

We now have a deer fence. As a city girl I thought deer were very cute, (still do), until they ate all the hosta leaves leaving me with stalks that look like celery! Then of course I placed good ferns in front of the hostas so to get to the hostas meant trampling the ferns. The fence has worked well as long as I close the gate. I once had to run out in the morning in my pajamas and before coffee, to help one poor doe get back to her children who wisely waited outside the fence.

The number of root wads has increased again to about 150. Many have been used to fill in, many went into the tunnel structure and now we are planning to use some to finish the exit. In the haste to finish the planting I ignored the areas around the entry and exit outside the stumpery. So this winter I have spent most of my time clearing both ends.

The entry way is finished and some planting has been done, The exit end is in progress and the goal is to add a semicircle of root wads so one can sit and look back into the stumpery.

This past winter has not been kind. The low temperature here was 17° F for perhaps five or six days straight. Highs were maybe in the upper 20's F. Unfortunately the weather still is cold and nothing is really eager to come out of the ground though today I found an epimedium in bloom. I did my tree fern ritual wrapping the trunks in aluminum foil and adding a heavy paper/foil material that had been laminated together, a winter cloth called Remay here. The crowns were packed with leaves and bracken then covered with Remay. But what to do about the fronds? On the *Dicksonia antarctica* the fronds were at least five feet long in most cases and because the past few winters have been warm they had several years of frond growth. With the cold we also had heavy snow and because I couldn't protect the fronds I had to cut them off which was a very sad moment for me. The good news is that the crowns seem to be fine and I can see new crosiers waiting for warmer weather. I was more carefree at least in attitude, with *Dicksonia fibrosa*, still doing the wrapping and the crowning protection. Most of their fronds are fine.

Dicksonia squarrosa is my worry. In the worst of it I resorted to encasing the whole plant including fronds in laminated foil after doing two layers of aluminum foil, packing the crowns first. I unwrapped every one about a month ago (early March) but kept the *D. squarrosa*'s trunks covered only removing everything to water the trunk. The fronds are a combination of green fronds and brown fronds so we will see how they do.

All the pyrosias, epiphytic rhododendrons and agapetes - all the things I had actually planted in stumps/root wads seem to have made it through just fine. Now there is the clean up of broken branches, cutting back fronds and moving ferns. When I first started planting I was overwhelmed not knowing how to design it - put all of one kind together in drifts or mix them up? I finally decided for sanity sake to do all of one species together only using drifts at the end to mix them so one flowed into the other. Now I feel more confident in mixing, at least a little. I've also learned more about my ferns and have moved some into more sun and the shadier loving ones into more shade. I had cyrtomiums in lots of sun but have now moved them all into more shade. This I learned after a lecture given by Sue Olsen.

Finally, the stumpery has created an amazing amount of interest - more than I could have imagined. Most ask about it with a certain chuckle in their voice. But once the stumpery is explained everyone wants to see it or contribute stumps. Usually it's, "I saw this great stump on Mount Rainier (only 300 miles away) you should have." We have been asked to open the garden on three occasions this coming summer - two are fund raisers. So the garden gives back as well. The stumpery gives back to me every time I am in it. I have so enjoyed this garden I never get tired of walking into it.

How to Grow Xeric Ferns

David Schwartz
Bakersfield, CA

I've often been asked, "Why desert ferns?" in response to queries concerning what my interests are...at least, that's the question after, "What's a desert fern?" The 'why' is much easier to answer than the 'what' but the 'what' is probably a more pertinent starting place. 'Xeric ferns' is actually a better fit than my standard 'desert ferns' answer, but people tend to be more struck by the oxymoronic concept of ferns in the desert so I start with that.

When I refer to desert/xeric ferns, I'm generally referring to ferns in the family Pteridaceae, sub-family Cheilanthesoideae. Almost all of these ferns are similarly adapted in how they deal with periodic dry seasons in that the foliage can become desiccated, dry and brittle, and when sufficient soil moisture and/or humidity is again present, that foliage will re-hydrate and become metabolically active. This is often true of the younger immature foliage, including crosiers in various stages of growth as well as sporangia that were immature at the time of desiccation. This ability to re-hydrate and become actively growing again after complete desiccation is found in young sporelings and even in some gametophytes.

These ferns can be found in a variety of locales and habitats from alpine to the dry tropics, but most tend to be found in Mediterranean to mid-latitude desert climates. Typically, they grow in and around rock outcrops, in poor, quick draining soils. Some prefer acid soils while others are primarily or exclusively calciphiles. Many are apogamous, a definite advantage in areas of seasonal or limited rainfall. Often times, they have some form of indument, scales or hairs or a combination of both, or farina, especially abaxially but occasionally adaxially also. These attributes pretty much answer the 'why' question. How could I not have such an interest?

My first exposure to xeric ferns occurred almost thirty years ago, driving in the oak woodlands around Napa Valley, CA in late summer. The grasses were that typical "golden" (although there are plenty who describe it as 'ugly brown and dry') color indicative of the "The Golden State". I spotted some purple clumps in amongst the dry grasses. Closer inspection brought the discovery of what looked (sort of) like what I had learned as a fern in my botany class. "Sort of" because, while the shape of the leaf fit the description of a fern, the hard, brittle texture and purple color definitely did not. A bit of research identified the plant as *Pellaea andromedifolia*, the coffee fern. From that discovery, a life long interest (some people mistake it as an obsession) in xeric ferns was born.

That obsession, excuse me, I mean interest, has lead me to collect plants and spore from whomever I could, to build and then expand my collection. I currently have in the neighborhood of thirty to thirty-five species of xeric ferns growing in my rock garden. Sitting under shade on the west side of the house there are another fifteen to twenty

species or sub-species potted as either specimen plants, or just waiting for me to find them a home in the rock garden. I also keep sporelings, and young or more tender plants in a greenhouse at the local Community College where I do occasional volunteer propagation.

How to grow xeric ferns...that is the crux of the matter. Since they typically grow in regions of seasonal dry periods, one might think that letting them go completely without water for an extended period would be beneficial, or even necessary - wrong! To be successful with these ferns, they should be grown in a well drained soil and watered regularly, letting the soil get nearly dry between waterings. While often growing in full sun in nature, under cultivation they tend to do best with some protection from the sun during the hottest part of the day during the peak of summer. That's the quick and easy recipe for growing xerics and it works fairly well, whether growing in pots or in the ground, especially in mild climates such as coastal and near coastal California from the San Francisco Bay area down to San Diego. Unfortunately, I (and most people) don't live in such mild climates.

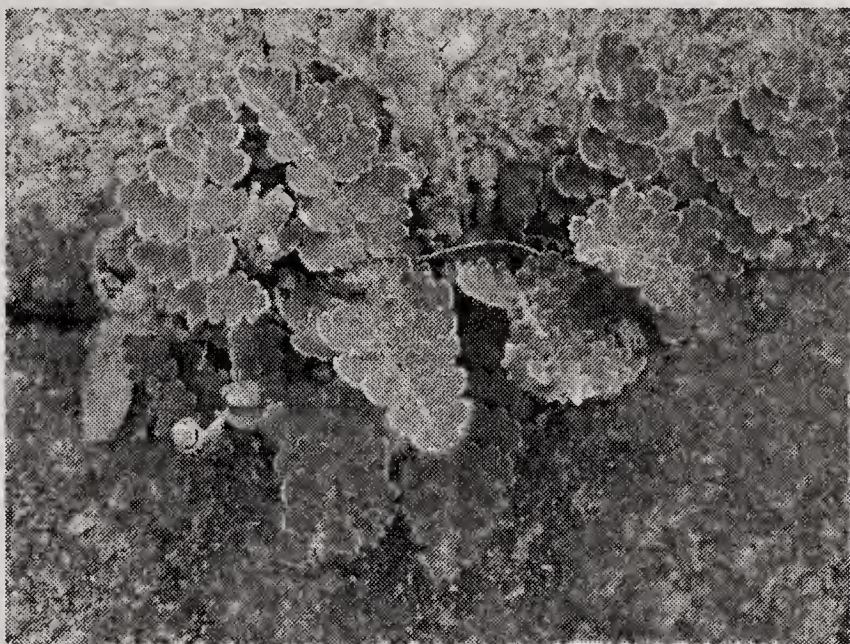
I live in Bakersfield, CA. Bakersfield is situated at the southern end of the San Joaquin Valley and, unlike the rest of the valley, Bakersfield is classified as a desert as opposed to the more moderate Mediterranean climate that surrounds it. We receive on average around six and a half inches of rain per year with around forty days during the summer with temps of 100° (F) or higher. We tend to be fairly mild during the winter with average minimum lows between 28° and 32° but occasionally we do reach the low to mid 20s. Summer highs tend to be more of an issue than winter lows here.

My small rock garden fronts the public sidewalk and street with a primarily northern



exposure. I have a rock lined path that leads south to the front entry and also leads to the side yard on the west. It is this path leading to the side yard that has the harshest southern exposure during the summer and poses the greatest challenge at that time of year. Because the garden fronts the street, I irrigate with a drip/mist system to try and keep things green and growing throughout the year.

The rock garden is built primarily of granite boulders ranging from head size to three or four cubic feet in size (I still had a working back at time I installed the garden). The rock garden was designed as a free form retaining wall which ranges in height from one to three feet, and functions not only as the habitat for the xeric ferns and small xeric perennials, but as the raised bed in which the Proteaceous garden is planted. The soil itself is an alkaline, loamy sand and is very free draining.



The soil is original in place and is part of the old river flood plain but at the time the subdivision was built, the ground was well packed...so well packed that when we moved in, I would end up using an iron digging bar to make planting holes. Even in the summer, surface water would stay in low places on the north side of the house without draining or evaporating between waterings. Since we had the house built and observed the construction process, I knew what kind of soil (almost pure sand in places) was below the compacted surface soil. I endeavored to remedy the soil compaction and over the course of six months or so, I dug by hand, down to a depth of between two-and-a-half to three feet, starting from the sidewalk and going to the house foundation (again, I *used* to have a back). When I was finished, I ended up having to have around seven yards of soil removed, and I still ended up with raised beds throughout the front yard - drainage achieved!

Over the years, I have (through trial and error...lots and lots of error) managed to find xerics ferns to fit the various exposures I have created. I have found that the most successful xerics for me have been those from the desert southwest, primarily AZ, NM and TX. These areas experience summer 'monsoons' which account for half of their annual rainfall. Ferns from this region seem more amenable to supplementary irrigation during the summer heat than those native ferns found in California with its more Mediterranean (summer dry/winter wet) climate.

California native xerics like *Pellaea andromedifolia*, *P. mucronata* or *Pentagramma triangularis* that were relatively easy to grow in the Bay Area struggle here in Bakersfield, especially in the ground with summer irrigation (although potted *Pellaea* ssp. with shade protection are successful). I have yet to be successful 'summering over' *Cheilanthes covillei* from local populations while the same (putative) species from east of Phoenix, AZ is thriving. The relatively common Asian species, *Aleuritopteris*

argentea takes multiple exposures quite well but sun with adequate water seems preferred. All of the *Astrolepis* species planted have done well, as have most species of *Notholaena* tried except for *N. californica*, which tends to struggle along for several years before succumbing. *Cheilanthes yavapensis* is a stand-out plant in amongst the rocks, while *C. lindheimeri* does especially well above the boulders in the Proteaceous bed where it has a chance to find the balance of moisture and dryness it prefers. One of more recent introductions that thrives in Bakersfield is the European/Mediterranean species *C. acrostica*.

Cheilanthes acrostica is the latest species to self sow in the rock garden. Others ferns that have self sown are *Notholaena grayi*, *N. lemmonii*, *Cheilanthes distans*, *C. lasiophylla*, *Astrolepis sinuata* and *Aleuritopteris argentea*. Having xeric ferns self sow was one of the goals in building the rock garden, and is one of the most rewarding aspects of the garden. As more species are introduced into the garden, I hope to increase the number that self sow, and validate the effort that has gone into creating this environment.

A Fern Table, Pro and Con

George Schenk
The Philippines

First, the con. "It is beyond the pale for a gardener to take over a perfectly good table and plant a garden on its top, at once rendering the table useless for any purpose in the real world, such as being a station for conviviality in the garden. The eventual consequence of gardening on the table will certainly be its decay and collapse, with attendant danger to limb and of litigation. Table gardening is illogical, and quite possibly illegal – or if not, should be." Such is the argument – or close to it (I've done a little coloring) – of the table gardening naysayer whom you may encounter among family or friends whose approval you seek when starting out. I've definitely heard such complaints about my own table gardening, and having heard them, have gone right ahead. Art trumps logic.

We who make table gardens have a pretty good argument of our own: There is no visual experience in all Nature, or in all other garden art, quite like that of pausing to peruse a table garden. The mesa landscape seems to float, lightly moored, above the earth-in-main. The sight is a visual intoxicant; the mind receives an agreeable jolt of disorientation, a shot of pure surrealism. It happens that the first table gardener, a practitioner at least in visionary terms, was the definitive surrealist René Magritte. He painted a picture of a garden on an oblong table quite plain in design (a plus in table gardening), white in color (a minus). Directly from the table top – no soil is present – grow three unidentifiable deciduous trees with twisty, black-brown trunks, and branches in summer leaf, green pointillistic dots.

All right, I invite you to become a horticultural surrealist. Begin with the sacrificial table. Any kind – one with a top of wood, metal, stone, or thick glass – will serve, as long as it is sturdy. The table legs, if of wood, should at best be 2 × 4's or not

much slighter. Ideally, table-top boards should be 1 5/8 inches thick; safely, 1 1/4 - to - one inch thick; daringly, 3/4 inch. The furniture most commonly available for our art is probably a wooden picnic table weathering away on a patio. And it is one of the best candidates for the job. My first table garden – a fern table on a former picnic table, is now eleven years old; the table top is of 1 5/8 inch thick western red cedar, probably the best table-gardening wood on the market. In a recent check on the condition of the wood, by digging down and exposing bare boards, we found minor, shallow decay caused by constant moisture – no insect damage; the top will likely remain sound for years longer.

But how about a garden on a table with no top – none, that is, in the usual sense. Several years ago, if memory serves – and it doesn't, I either read an article by, or was told about, a table gardener who uses screen of a stiff and substantial kind (must be of metal) as the platform for a garden on a table otherwise ordinary in its legs and frame. My apology for not being able to tell you more. It seems I've studiously unremembered any of the engineering of the screen-top table because the concept strikes me, a shaman no less, of classic solid top table gardening, as heresy, an invasion of practicality upon an art whose charm is in being utterly impractical. Yet, I've got to say that a screen top seems a deplorably good idea.

Use a composty soil mix for a fern table, but make sure the mix contains plenty of sand (many commercial mixes have little or none) to prevent the eventual caking of the mix to a state of airlessness. In a writing of mine on other pages I suggest adding sand to make up 25% of the mix. After having monitored my earlier table gardens for some years, I've concluded that a measure of 1/3 or more of sand in the total volume of the mix would be better. It is important to use a coarse sand that has been washed free of silt – as in the commodity sometimes called “builder's sand” in sales' yards where sand is available as an ingredient for concrete mixes.

Place the soil mix on the table to a thickness of about nine inches or more, toward the center of the table top – soil to the maximum that you can get to stay in place. Along the edge of the table top lay a line of plants, or possibly of small stones, to hold the soil. Plants should be placed sidewise so that their foliage faces outward more than upward. Push a tide of soil from the center of the table up against any edging stones, or over the roots of edging plants. These might be any of hundreds of rock garden plants suitable as well for table gardening. Several that I can think of off hand and in no particular order of preference, include *Homalothecium* and *Polytrichum* mosses, *Cotoneaster congestus* 'Cooperi', *Campanula portenschlagiana*, *Hebe lycopodioides*, *Vaccinium vitis-idaea* 'Minor', *Rhododendron radicans*, *Sedum reflexum*, *Sedum album*, *Blechnum penna-marina*, *Cotula minor*, *Cotula perpusilla*, *Gaultheria nummulariifolia*, *Gaultheria procumbens* and *Selaginella kraussiana*.

Arrange sizable stones (say, those of one-to-two feet in diameter), or pieces of stumpy garden wood, on the smoothed and lightly tamped table-top soil – if you are going to use either of these landscape elements; they can be of great value in adding a complementary contrast of solidness and settledness to the buoyancy of ferns in the garden composition. Rocks are the natural habitat of petrophytic ferns, generally small growers, that like nothing better than a firm grip on life in an interstice between two rocks that the gardener kindly places together for them, and there wedges them into the crack.

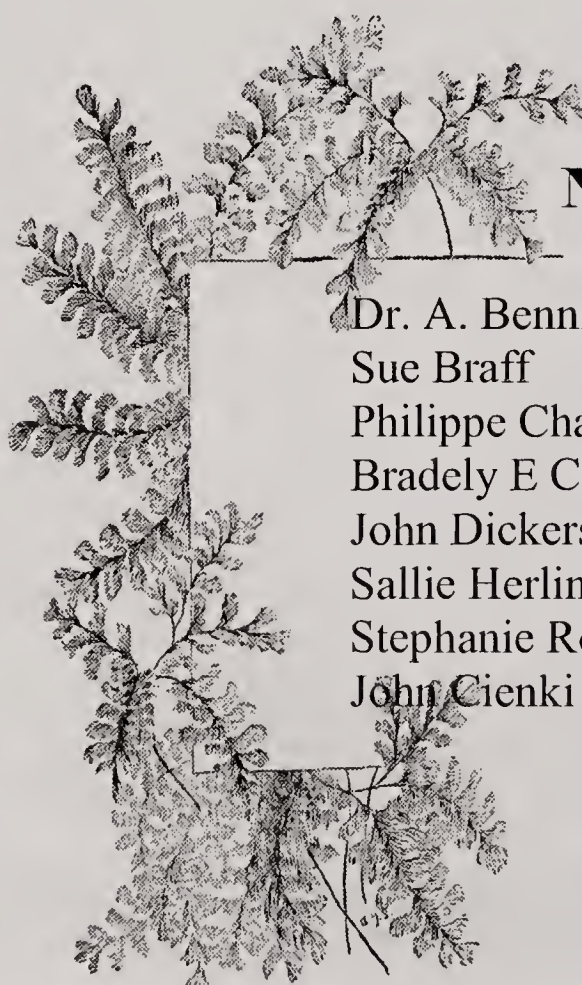
Larger ferns – but not overly large kinds, those that make upright growth as much as about two feet tall, or that grow as much as two feet wide in the spread of their

fronds, are of a size that will fit the table top garden easily, forming there the central and coordinating element in the composition. These ferns can be any of a thousand or two species and varieties, including favorites of yours. In that case there is probably little excuse for my naming any that come especially to my mind. But, having posted that caveat, I'll name these: *Adiantum aleuticum* 'Subpumilum', *Asplenium trichomanes*, and *A. t.* 'Incisum', *Athyrium filix-femina* 'Minutissimum', *A. f-f.* 'Frizelliae', *Athyrium otophorum*, *Blechnum penna-marina*, *Ceterach officinarum*, *Cheilanthes tomentosa*, *Cyrtomium falcatum*, *Dryopteris erythrosora*, *Gymnocarpium dryopteris*, *G. disjunctum* - pushy, but worth the slight bother of pushing back by cutting out transplantable clumps, roots, soil and all, from the edges of the colony - *Phyllitis scolopendrium* and its cultivated varieties, *Polypodium glycyrrhiza* 'Malahatense', and *Polystichum polyblepharum*.

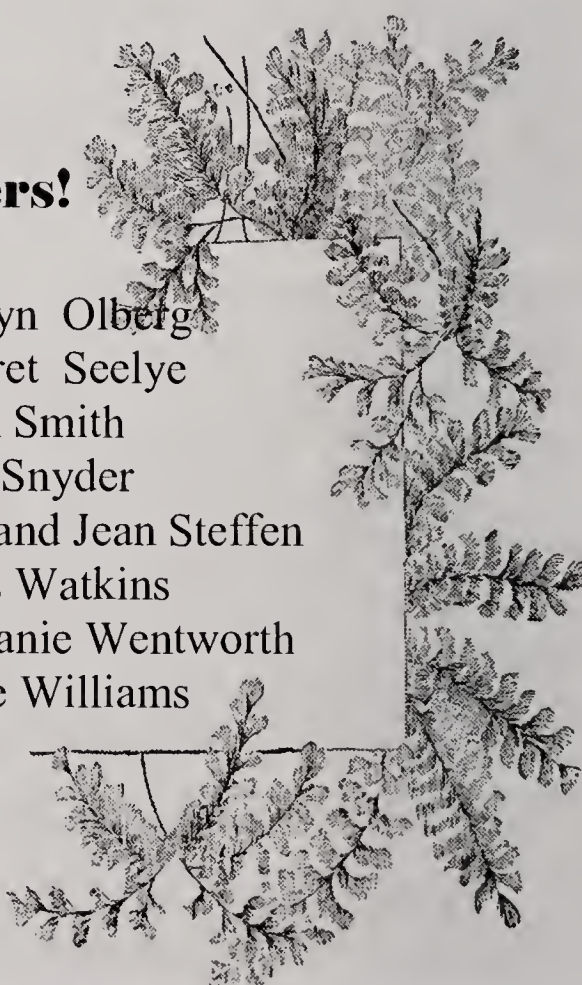
The garden is almost complete. Give it the finishing touch of a carpeting moss such as *Homalothecium* to cover bare soil between the ferns and any other plants, and you may well receive from some visitor the kindest words a landscape gardener can hear: "It looks as if it has always been there".

Caring for the fern table is first of all, and unendingly, the chore of watering – on most days during rainless weather in spring, summer and fall, and watchfully in winter. If you've had the patience and persistence to have been a good gardener of moisture-needy plants in pots or tubs, you have exactly the temperament to be the keeper of a fern table; it is only a grander kind of container garden. Fertilizing is another repetitive demand of the fern table. Use whatever fertilizer you prefer. I use a "complete" fertilizer with added trace elements, in the form of a wettable powder that I apply, inexactly, every several weeks during the growing season, at half the strength recommended on the package: this, after having chemically burned plants that I fed as directed. There will be an occasional wind-borne weed and table-climbing mollusk for you to oust – but not much else to do other than stand there and admire the living proof of your ability as a conjurer. A fern table is garden magic.

Welcome New Members!



Dr. A. Benniamin
Sue Braff
Philippe Chatelain
Bradely E Christian
John Dickerson
Sallie Herling
Stephanie Rodden
John Cienki



Carolyn Olberg
Margret Seelye
Karen Smith
Mary Snyder
Gary and Jean Steffen
James Watkins
Stephanie Wentworth
Elaine Williams

How to Provide Winter Care for Tree Ferns

HFF Brochure

These handsome ancient plants are a popular attraction in warm gardens, but unfortunately not reliably hardy in the greater Seattle or similar areas. *Dicksonia antarctica* is the most cold tolerant of the lot, but all tree ferns need special care and winter protection. Site them in the warmest section of the garden. A shady nook on the south side of the house (away from cold north winds) is ideal. During the winter months, when the plants are young and containerized, the entire plant can be brought inside to the warmth of a greenhouse or suitably comfortable site in filtered light. Once the plant gains height and remains in the ground it will need protection from the cold. A hefty mulch at the base and a simple wrap of burlap or horticultural gauze around the trunk can be sufficient in mild weather. However, in more severe cold the trunk needs greater insulation. Experts use various techniques. One of the easiest is to wrap the trunk in bubble wrap and then cover this with an additional blanket of burlap or similar material. (Bubble wrap alone should not be used as it magnifies sunlight which will burn the plant.) Straw or similar material may be tucked into the crown to keep ice from forming. Some gardeners also wrap the fronds which if left exposed will burn and brown in a severe frost. They should be held up vertically, not pulled down, and tied with a loose wrapping. Be advised that the fronds will likely be damaged in the process. Note that all of these precautions should be in place before an arctic blast arrives. Good luck!!

The following hands on evaluation is a reprint from the Hardy Fern Foundation Newsletter Volume 7 Number 2, Spring 1997

Cultivation of Tree Ferns in Cold Climates

Martin Rickard, Tenbury Wells, England

Tree ferns are not reckoned to be very hardy, but quite a few can stand a few degrees of frost. I hope this is hardy enough to interest members of the HFF. I have been playing with these magnificent plants here in a cold part of the English West Midlands for some time and hopefully my experiences will be of interest.

In the early 1980's I acquired my first plant of *Dicksonia antarctica*. I put straw over it in the autumn and never saw it again! In the mid 1980's I was given a second plant. It had no trunk but the fronds were about one yard long. For winter I lifted the fronds vertically and packed straw bales around the outside of the whole plant. I covered the lot with a glass sheet. That winter we dropped to -15°C and my little *Dicksonia* did not mind at all. Encouraged by this first winter's success I acquired another plant of *D. antarctica* this time with a three foot trunk. This I planted next to the smaller specimen and protected it with polystyrene trays tied around the trunk with straw rammed down inside the polystyrene. The crown was covered with straw which was in turn covered with a polystyrene plate. This was then surrounded by a wall of straw bales around both plants. The top of the shelter was uncovered except in frosty weather when a sheet of polythene was pulled over the entire structure. In very cold weather this was

supplemented by a sheet of space blanket. Both plants survived the next winter which was average with a minimum of -10°C .

Again encouraged by this success I experimented with other species in similar shelters:

- a) *Dicksonia fibrosa* was a great success. From no trunk it grew to about one foot tall in five or six years.
- b) *Cyathea cooperi* survived four winters but did not flourish. Perhaps it was too dry. The plant is now a fine specimen kept in a cold greenhouse.
- c) *Cibotium menziesii* like *Cyathea cooperi* survived but did not flourish, probably for the same reasons.
- d) *Lophosoria quadripinnata* from Mexico – same as *C. cooperi*
- e) *Marattia* sp. survived one winter and died during the second. It must have survived temperatures around -5°C at least. Temperatures outside the shelter were about -10°C .
- f) *Cyathea princeps* died after seemingly thriving for two winters and three summers. Perhaps it became too dry.
- g) *Cyathea australis* died during the second winter. Again, too dry?
- h) *Cyathea* spp. from Mexico as very young plants. Various unnamed species dwindled over two or three years. Larger plants might have fared better.
- i) *Dicksonia lanata* Tried twice and they twice died the first winter. I do not know why!

I recently moved, hence the transfer of some plants to a cold greenhouse. My *D. antarctica* plants have been replanted outside and I now have two techniques under test. 'Belt and braces' as described above although I no longer cover with a sheet in frosty weather. The second system is the same except the surrounding straw bales are not used. both systems have worked well now for years. The leaves are always lost, but the plant regrows.

Local to me, nursery stock of *D. antarctica* was left completely unprotected all winter except for a handful of leaf litter pushed into each crown. All plants with trunks two feet or more tall survived. This was an average winter for us with the minimum -10°C but the cold weather at times went on for weeks with daily maxima often only -5°C . I had a similar experience in my unheated shed last winter when I lost a lot of plants with six inch trunks. These included *D. antarctica*, *D. fibrosa* and *D. squarrosa*. Larger plants with trunks two feet or more tall were again fine, although I lost a newly imported six foot *D. fibrosa*. I think newly imported material needs special protection for the first winter until the roots are properly established.

So despite the failures there were quite a few successes. I know it is cheating to provide shelter, but it is well worth it if, like me, you love tree ferns.

Container Gardening with Ferns

Richie Steffen

Curator, Elisabeth C. Miller Botanical Garden
Seattle, WA

The varied textures and interesting leaf shapes of ferns make them ideal candidates for container gardening. They can be either a supporting character or the whole body of a stylish and eye catching design. I find that I use ferns in several ways around my house and at the botanical garden where I work. Some pots hold bold architectural ferns as a single specimen providing a dramatic centerpiece surrounded by smaller complimentary containers. Others hold rhododendrons and other woody plants dominating large heavy frost proof ceramic pots with a billow of fronds below creating a lush groundcover over the pot. Many of the containerized ferns grown are hardy perennial subjects remaining outside virtually unprotected through the winter. If you are concerned about winter hardiness in containers it is best to choose plants that are at least one USDA zone hardier than the zone you live in. Unfortunately, I also have a weakness for the tender and marginally hardy selections. These plants will remain outside until the last possible moment then are moved inside for the winter. If they are almost hardy, I only move them inside for the very coldest of weather then return them to a sheltered location once the deep freeze has passed.

Here are some temperature tips for sheltering plants.

- If the temperature drops below 40 degrees F (4 degrees C), all tropical ferns are brought inside where they will remain for winter.
- If the temperature drops below 28 degrees F (-2 degrees C), all ferns hardy in USDA zone 9 are protected in unheated structures (a garage generally is fine) then returned outside once temperatures warm.
- If the temperature drops below 20 degrees F (-7 degrees C), all ferns hardy in USDA zone 8 are protected in unheated structures and zone 9 ferns are brought inside until outside temperatures warm
- If your temperature regularly drops into the teens or lower all your containers will likely need good winter protection, and should be stored in an almost frost free place or buried in mulch for the winter. All marginal and tropical ferns should be kept inside or in a bright cool frost free location until spring.

All of this may sound like a bit much, but I can assure you there are worse vices in this world. I have long ago accepted my fate to occasionally have my living room become a jungle of almost hardy plants a few times each winter. I urge others to join my ranks.

Think of your pots as places to show off the best in your garden and use them where their impact will be maximized. Near doorways and patios are ideal locations. Try to

keep in mind that they will need watering so do not stray too far from a hose. I try to refresh the plantings every year, taking the spring to see what looks good and what needs to be replaced. I also check the condition of the soil. If it looks too compacted it is best to take the container apart and add fresh soil.

When putting together a mixed planting there are numerous articles and books on the mechanics and design principles. The best advice I can give is to use some of the following helpful hints and to have it be an enjoyable event. There is no use in going through the trouble if the pot just reminds you of a troublesome garden adventure. Here are several guidelines I try to keep in mind while designing a container.

About the container:

- Buy as big as you can. The larger the container the more you can do with it and it will be slower to dry out in the heat of the summer.
- Look for frost proof pots. There are several high fired crack resistant ceramic containers available now. They look great and come in a remarkable array of colors and finishes. If weight is an issue look for resin or plastic containers. These have come a long way since their introduction and are becoming more affordable. They are durable, long lasting and are surprisingly lightweight. Plastic pots are the standard of lightweight containers and can be quite inexpensive. Unfortunately, many of the least expensive options also look cheap. If you are looking to save money on the pot, then spend more on the plants and choose selections that will cascade down and help hide the container.
- Try to stick with a theme. Collect containers that look similar or compliment each other. This will allow you to have more diversity in the plants and build cohesion in the garden.

About the soil:

- I plan for containers with perennial plants to last for about two to three years. The usual container soil mixes have a substantial amount of peat moss. Over the course of a year peat moss decomposes into a heavy muck and is best for one year of use. I prefer a much lighter soil mix with bark, compost and pumice or gravel. I avoid perlite because of its ugly tendency to float to the surface after each watering. The extra coarse material is much slower to decompose allowing for more air to reach the roots. This lighter mix is especially good for the Northwest where heavy winter rains can drown plants in dense soils. In warmer areas use less gravel and more bark to help retain more moisture while still keeping the mix light and airy. It is always a good idea to check with the local Cooperative Extension Service for other container mixes that will hold up well in your climate. I have included some soil mixes that have worked well for me, start with these and adjust for your climate.
- This basic mix will work well for most ferns, but there are special cases. More gravel and pumice are added for alpine plantings and for some ferns that always like their feet wet I use the old standard potting soil mixes made with peat moss.

About the design:

Start with a focal point. This can either be a striking specimen fern, a choice woody ornamental, or an interesting twisted piece of wood or shapely stone. Don't get tied down with working with odd numbers of plants or about placing plants from the tallest to the smallest. These are helpful rules, but the idea is to have fun and end up with something you enjoy. The more you let your imagination run with the planting the less you will rely on any rules.

Use texture and color boldly. Container plantings are supposed to draw the attention of the viewer. Sometimes it helps to keep it simple. A single beautiful fern surrounded by moss in an elegant container can show the height of taste and fashion.

Add bulbs to the mix. Lilies, *Arisaema*, and other seasonal bulbs add a bit of surprise to the package. They will seemingly spring up from nowhere and provide a dazzling dramatic element to the container composition.

About the maintenance:

- Watering will be the most critical aspect for a successful container planting. During the growing season it will need to be checked daily. If the surface is dry water gently. If the container does dry out it is important to give it several gentle waterings to make sure the soil has fully rehydrated. Poke your finger into the planting to make sure the water has penetrated and is not just running off and down the insides of the pot.
- By choosing sturdy reliable plants you can eliminate dealing with many pests or diseases. The biggest problems I have had to deal with are slugs and occasionally aphids. Slugs can easily be taken care of through the discreet use of baits or by placing the container in an inaccessible location. Aphids seem to only be a problem for a short period in the spring. When noticed, I use an appropriate insecticide and spot spray the plant. Refrain from spraying the entire container, as it is easy to damage the newly emerging fronds and the spray can kill beneficial predators hiding in neighboring plants.
- I prefer a slow release fertilizer because I know I will not remember to liquid feed regularly. Either will do a great job at keeping the container looking lush and fresh. Use a balanced all purpose fertilizer for the best results. Sometimes the slow release loses its punch toward the end of summer. Rather than applying a second dose I will use liquid feeds about every other week until mid-August. In August I stop all feeding to insure that the ferns enter their fall dormancy properly hardened off.
- Containers are all about looks. If a fern burns in the summer heat do not hesitate to replace it. In mid to late summer it is often difficult to find large hardy ferns so try a tropical fern. It will fill the void and look great through the remainder of the growing season. Tropical ferns are widely available and can be found at very reasonable prices. It is worth every penny to replace a languishing fern with a lush tropical to keep a container in a prime location looking its best.

I hope these words of advice help keep your garden looking its best for the upcoming season. Containers can and are wonderful elements that can allow anyone to have a garden. I think the part of container gardening I enjoy the most is that your imagination is your only limitation, so be creative and enjoy!

Soil Mixes

Miller Garden Container Mix

Developed by the Elisabeth C. Miller Garden and Specialty Soils, Covington, WA

This will make a little over 2 cubic yards of soil

- 1/2 cubic yard pumice
- 1 1/2 cubic yards medium bark (aged)
- 1/3 cubic yard coarse compost
- 3/4 pounds ferrous sulfate
- 1 1/2 pounds gypsum
- 2 pounds dolomite lime
- 1 1/2 ounces trace elements

Soil pH should run around 5-6

If you just need a little soil try this.

Richie's Down and Dirty Quick Mix

- 1 part clean coarse compost
 - 2 parts medium bark (aged preferred)
 - 2 to 3 parts pumice or pea gravel (or perlite as a last resort)
- You are on your own for the micro nutrients and pH

Both of these are great all purpose mixes that will hold up well over time, especially for woody plants and perennials in containers. This can also be used as a nursery pot soil mix.



Pyrrosia polydactyla, *Pyrrosia lingua* 'Shishi', *Pyrrosia lingua* 'Kei Kan' Photo by Richie Steffen

Growing Lime-Loving Ferns in Tufa in Vermont

Don Avery
Cady Falls Nursery
Morrisville, VT

My initial reason for building the tufa garden was for growing lime-loving alpine plants, especially those in the genera *Saxifraga*, *Androsdace*, *Salix* and *Daphne*. After initial success with some of these plants, it became apparent that the same cool north-facing rocks and crevices would be ideal for some of the calciphilic fern species from which I had been collecting spore on yearly forays into Canada. I had been tremendously inspired when I had seen ferns growing in profusion on limestone cliff faces and in limestone screes in the Gaspé Peninsula. *Asplenium viride* and *Dryopteris fragrans* are rather ubiquitous rock dwellers on the northwest coast of the Gaspé but are quite rare in Vermont. *Polystichum lonchitis*, unknown in Vermont, is found in profusion in isolated wooded limestone scree locations in the Gaspé. Another rare calciphile that intrigued me was *Asplenium scolopendrium* var. *americanum*, very rare in the US but common in the rich woods of the Niagara Escarpment on the Bruce Peninsula in Ontario. A few other lime-loving Vermont natives seemed worth trying in the tufa also. I had in mind *Pellaea atropurpurea*, *Cryptogramma stelleri* and *Woodsia glabella*, all of which are difficult to grow in cultivation and not commonly found in fern collections in the Northeast.

Tufa has long been known to rock gardeners as the ultimate substrate for coaxing along reluctant, hard-to-grow alpine plants. Lacking access to tufa, most experienced alpine gardeners grow their plants in crevices between closely spaced rocks in some kind of well-drained substrate containing little or no garden soil. In a true tufa garden however, the plants are grown within the rock itself. Small holes are drilled into the soft rock and the roots of seedlings or rooted cuttings are teased down into the holes. It is this method that I applied to the calciphilic ferns.

Tufa is found worldwide in regions of limestone karst topography. Over the course of millions of years calcium accumulated on the ocean floor from the deposition of fish bones and coral and, with the passing of geological time, these deposits eventually emerged out of the ocean and hardened into what we call limestone. Compared to other rock types, limestone is generally soft and water soluble. In certain instances where large quantities of water move through limestone deposits, calcium is dissolved in the water and carried away. If the water becomes stagnant, over time it evaporates and the calcium, which has been held in solution, precipitates out. As time passes, the deposit hardens into tufa that is nearly pure calcium carbonate with traces of other minerals (especially iron) along with the fossilized remains of plants and invertebrates. Tufa is very porous and much lighter than limestone and is easily colonized by plant roots. When it is first dug out of the earth, it is nearly bone white, but with exposure to sunlight and air, it takes on a beautiful grey patina.

The only tufa garden with which I am intimately familiar is my own, and I will explain

here how it was constructed and how the plants were established. From the beginning I was convinced that a north-facing wall, open to the sky, offered the best possibilities. This inspiration came from a wall garden that I had built out of local stone in 1986, and which has proven to be a natural haven for fern sporelings, including unexpected volunteers of *Polystichum braunii*, *Adiantum pedatum*, *Dryopteris cristata*, and *Asplenium trichomanes*.

Since my goal was to create the effect of a natural outcropping, the tufa wall was constructed differently from a traditional wall garden. I selected the largest pieces of tufa available to me at the time, 10-18 inch diameter, and I stepped them back toward the bank at an angle of about 30 degrees, placing the stones as close together as possible and avoiding straight lines. The base of the wall was set in a 6 inch deep bed of fine mortar sand and the upper stones were backfilled with a 6 inch thick layer of the same material.

My idea was to keep the sand wet and to allow the tufa to wick up moisture. To accomplish this, I laid out a length of soaker hose along the upper rim of the wall on top of the sand layer. After the first year, it became apparent that this method was not keeping the tufa evenly moist. In some places the tufa was dry while nearby, the soaker tended to wash the sand out from the bottom of the wall. To remedy this, I installed a series of commercial, 1/2 gal per hour, drip irrigation emitters. These were connected to a garden hose which is left on from May to Oct. With this arrangement, the tufa never dries out and the lower stones are always cool and moist to the touch. I believe that this ever present moisture is the key to the success of the tufa garden.

The tufa wall was built in the fall of 2003 and planting began in the spring of 2004 when, along with the first alpines, I planted *Asplenium viride* and *Pellaea atropurpurea*. In 2005 and 2006 I continued to add ferns to the collection.

Whenever possible, I have planted sporelings in holes 7/8 inch in diameter by 2½ inches deep, taking care not to drill all the way through the tufa. No special tools are needed to drill the soft rock as it is easily bored into with a cheap wood bit run by a battery operated hand drill. I think it is very important to get rid of all remnants of organic potting mix before setting out the plants in the holes and I am especially wary of compost and bark based mixes. I bare root the plants and wash them off in a bucket of water before inserting them in the tufa. After teasing the roots of the ferns into the holes, I carefully backfill the holes with a mixture of crumbled tufa chips and fine peat based potting mix. I try to avoid incorporating too much of the fine tufa powder that came from the drilling of the holes. As much as these plants love calcium, I suspect that few would appreciate being planted directly in powdered calcium carbonate. I find that I can use a small funnel and the eraser end of a pencil to tease the mix into the holes and around the small roots. I water the plants in afterward using a plastic spray bottle. I have occasionally given the transplants a small dose of diluted liquid fertilizer to help them make the transition from potting soil to tufa.

In some instances, the ferns have been too large to plant in drilled holes and so I planted them in between the tufa stones, backfilling with crumbled tufa and fine sand. It seemed that this would allow the roots to penetrate into the wet sand and into the natural soil

behind, and/or to grow into the calcareous rock.

The three or four years these ferns have been planted out is not a very long time by gardening standards and I am not inclined to start crowing with pride just yet. Any old garden hands know that it is only with humility that we are allowed to claim any success in the tricky business of horticulture. I can report, however, that I am thrilled to see how happy most of these ferns are in the tufa habitat.

The *Asplenium viride* are doing especially well as are the *Dryopteris fragrans*. The *A. viride* is the quintessential tidy alpine specimen, standing brave and upright on a near vertical face. My plants of *Cryptogramma stelleri* were too big for planting in drilled holes and I have been amazed at how fast they have colonized the crevices between the stones. *Asplenium scolopendrium*, also planted in a crevice, has flourished beyond anything I could have hoped for. My single specimen gets far more direct sun light in the afternoon than I would prefer, however the fronds are 12 inches long, perfectly green and have been loaded with spores the last two years.

I have *Asplenium rhizophyllum* in two locations, one in a drilled hole and another nestled between the stones. They are all growing slowly and are beginning to show signs of "walking" but the fronds have never had good green color. I am sure that many of these ferns would benefit from more sun protection as well as an occasional drop of dilute liquid fertilizer.

Pellaea atropurpurea has behaved much as it has in my limy rock garden, by fading away and leaving behind several healthy and promising sporelings. *Polystichum lonchitis* is alive and healthy but very slow growing. I have three *Woodsia glabella* planted in holes on a wet mossy face toward the bottom of the tufa wall. They were planted in 2007 and did remarkably well until August 2008, when they suddenly went dormant, I hope not forever.

My initial plantings also included two plants of the sun loving serpentinophile, *Polystichum scopulinum*, but these dwindled away the first year. Although my original batch of sporelings was very promising, I have had no luck growing this fern anywhere in the garden.

My tufa garden is 18 to 36 inches high and 14 feet long and consumed about a ton of rock. Those gardeners who don't have access to large quantities of tufa should not be discouraged because it is possible to make a perfectly enjoyable tufa garden with as little as one large stone. In any case I would suggest that you use the largest chunks that you can get and the heaviest pieces that you are able to handle. For growing ferns, face the garden away from the sun and always remember that the tufa must be able to wick up moisture, especially during the summer months. I have a friend who has managed beautifully with an 18 inch boulder set in shallow water at the edge of a pond.

The primary obstacle to making a tufa garden is locating a source of the material. At the present time, as far as I know, tufa is only available from two quarries, both in British Colombia. They will ship it to you by the ton. Tufa rock is not especially expensive, but it can be very expensive to ship it great distances. If you and your gardening friends can

not use a full ton, I suggest that you contact one of the retail sources that purchase their tufa in bulk from the quarries. I have listed below the names of the quarries and the outlets that I know of in the US, as well as one in Ontario. To find out about numerous other sources in Canada, contact Rocky Mt Tufa directly. Good luck!

Rocky Mountain Tufa Ltd. (Quarry)
P.O. Box 66 V0A 1B0, BC Canada
Phone: 250-341-6865
<http://www.tufa.bc.ca/index.php>

Golden Rock Products (Quarry)
Kimberley, BC.
Phone: 250-344-8999
<http://www.goldenrockproducts.com/company.html>

Wrightman Alpines
RR#3 1503 Napperton Drive Kerwood
Ontario Canada N0M 2B0
Phone: 519-247-3751
wrightmanalpines.com

Tower Perennial Gardens
4010 E. Jameson Rd.
Spokane, WA 99223
Ph: 509-448-6778

The Flower Factory
4062 Hwy A
Stoughton, WI 53589
Ph: 608-873-8329

Herbie Rocks Tufa
John Altman
300 North Market St.
New Wilmington, PA 16142
Ph: 724-971-2509

Marcellus Nursery Inc.
5062 Onondaga Rd.
Syracuse, NY 13215
Ph: 315-488-2632

Bristle's Garden Centre
7454 State Route 96
Victor, NY 14564
Ph: 585-924-2274

Sara Garden Centre
5900 Youngers Rd.
Bliss, NY 14024
Ph: 585-637-4745

Jon Marett
445 Glencastle Dr.
Atlanta, GA 30327
Ph: 404-925-5501

38th Annual

Hardy Fern Foundation Fern Festival

Friday, June 5th

Plant Sale ~ 1:00 – 6:30 p.m.

Lecture ~ 7:00 p.m. by local fern expert, Sue Olsen.

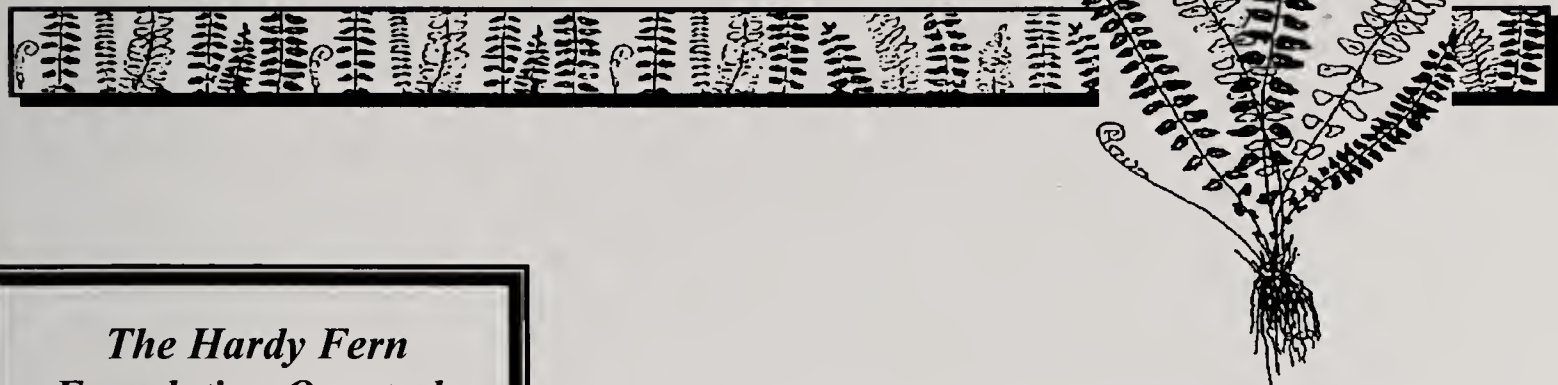
Ferns of the World

Where to find them and how to grow them

Saturday, June 6th

Plant Sale ~ 10:00 a.m. – 2:00 p.m.

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